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ABSTRACT

This document contains five working papers featuring employment projections for five segments of industry in Ohio. The purpose of the studies described in the papers is to evaluate projections generated by the quantitative models used in the projections process and to elicit insights and qualitative information from industry practitioners that are not otherwise available to analysts. The methodology for these projections involves a projection of Ohio's share of national industry employment for each industrial sector. This share projection is then fitted to the Bureau of Labor Statistics' projection for each industry to estimate Ohio's employment in the sector in the target year. These sectoral employment projections are then fitted to industry-specific staffing patterns derived from periodic surveys of Ohio business establishments adjusted by a set of change factors to anticipate the effects of technical change on the occupational mix. These final estimates of future occupational requirements are then adjusted by a set of occupation-specific replacement rates to estimate total requirements. The more qualitative analysis represented by the working papers reflects a concern with the validity of long-term projection models in periods and in areas affected by extreme structural change and/or severe economic fluctuations. The employment projections in these five papers are for the primary metals industry; fabricated metal products; machinery industry (except electrical); electrical and electronic machinery, equipment, and supplies; and transportation equipment. The package also includes a report on a test of the Occupational Area-specific Staffing Information System (OASIS). (KC)

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Employment Projections in the Primary Metals Industry

This working paper on employment in Ohio's primary metals industry is a component of a continuing program of occupational projections designed to provide labor market information to students, employers and educational and training institutions in Ohio. It develops estimates of non-agricultural wage and salary employment and replacement requirements for nearly 1,600 specific occupations in 340 of Ohio's industrial sectors. Projections for 1990, made in 1980, are now being revised on the basis of more current data and estimates for 1995 are in process.

This paper is one of a series of studies of specific sectors that are apparently undergoing severe structural change or accelerated growth. Their purpose is to evaluate projections generated by the quantitative models used in the projections process and to elicit insights and qualitative information from industry practitioners not otherwise available to analysts.

The basic methodology for these projections involves a projection of Ohio's share of national industry employment for each industrial sector. This share projection is then fitted to the Bureau of Labor Statistics' projection for each industry to estimate Ohio's employment in the sector in the target year.

These sectoral employment projections are then fitted to industry-specific staffing patterns derived from periodic surveys of Ohio business establishments adjusted by a set of change factors to anticipate the effects

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of technical change on the occupational mix. These final estimates of future occupational requirements are then adjusted by a set of occupation-specific replacement rates to estimate total requirements.

In brief, the Bureau of Labor Statistics projections of national industry employment requirements are estimated by an analytic model that uses the Chase-Econometrics macro-economic model to estimate gross national product. The projected GNP is allocated to producing sectors by a set of empirically derived consumption functions and the U.S. inter-industry (input-output) model to estimate sector output. Sector labor inputs are estimated by applying sectoral production functions to projected outputs.

The Ohio share of projected national industry employment is estimated by the application of simple and multiple regression models to time-series data on Ohio employment and on Ohio's share. The regression models used vary from sector to sector, depending on the characteristics of the sector and the quality of the historical data.

The more qualitative analysis represented by the working papers reflects a concern with the validity of long-term projection models in periods and in areas affected by extreme structural change and/or severe economic fluctuations. Because the Ohio employment projections are intended to provide criteria for career choice, labor-market strategies, and investments in education and training, they are necessarily long term. They are intended to be long-term trend projections rather than estimates of employment in any specific year. The 1990 projection represents a position on the trend line. Actual employment in that year may deviate from trend due to short-term forces including the business cycle or short-run policy interventions.

However, several industrial sectors among durable goods industries are currently affected by extreme changes in the short-term, in particular a severe recession in investment in plant and equipment, high interest rates contributing both to demand deficiencies and the high cost of modernization, and the impact on domestic supply of imports encouraged by current international exchange rates.

The analysis of long-term trends is obviously complicated by the difficulty of estimating the extent to which the magnitude and persistence of these "short-term" forces will produce or have produced a shift in the long-term trend for Ohio industry, and whether such a shift may be further enhanced by the stimulus these forces provide to reduce costs through accelerated technical change, capacity reduction or plant relocations.

In general, the working papers examine, within the limits of available data, anticipated changes in product demand, the impact of foreign trade on demand from domestic sources, the impact of technical change on the level of employment, and the evidence on the effect of geographic shifts in plant location on Ohio employment. The analysis is almost purely quantitative and relatively aggregate.

Their objective is to provide a framework for eliciting insight, qualitative judgments, or informed opinion on the impact of these current conditions on managerial decisions concerning capacity growth or reduction, changes in product lines or plant location, the adoption of labor-saving technologies, changes in the source of supply of inputs, and other factors that will affect the long-term demand for labor in the industry as a whole and Ohio's share of industry employment.

SECTOR 33

Primary Metals Industry

WORKING DRAFT

April 1985

(For discussion only)

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Sector 33

Primary Metals Industries

This industry group, a basic industry in Ohio's economy with 3.5 percent of the state's employment in 1979, includes blast furnaces, steel works and rolling and finishing mills (SIC 331), iron and steel foundries (SIC 332), primary smelting and refining of non-ferrous metals (SIC 333), secondary smelting and refining of non-ferrous metals (SIC 334), rolling drawing and extruding of non-ferrous metals (SIC 335), non-ferrous foundries (SIC 336), and miscellaneous primary metal products (SIC 339).

Structure: The commodity composition or structure of Ohio's primary metals industry is not radically different than that of the national industry, although the state has a negligible share of industry employment in smelting and refining of non-ferrous metals and in miscellaneous primary metal products (SIC 333, 334 and 339). These three sectors had less than 5 percent of the industry employment in 1979 and only 5.4 percent in 1983.

Slightly more than half of Ohio's employment in the industry group in 1983 was in SIC 331--blast furnaces, etc., and about 20 percent in iron and steel foundries. The residual was in non-ferrous rolling and drawing (17.3 percent) and in non-ferrous foundries (7.8 percent).

Employment in sector 331 is concentrated in blast furnaces with 81 percent of the total. About 12 percent are employed in cold finishing or in the production of steel pipes and tubes. In sector 332, nearly two-thirds of all employees are in grey-iron foundries and 30 percent are in steel foundries. Employment in sector 335 is also highly concentrated with 56 percent in drawing and insulating non-ferrous wire and 24 percent in the

Ohio and U.S. Employment (percent)

SIC	1979 Ohio	1979 U.S.	1983 Ohio	1983 U.S.
331	52.9%	45.4%	50.6	40.9%
332	21.3	19.1	19.5	16.9
333	2.1	5.7	2.1	6.0
334	1.4	2.0	1.6	2.3
335	13.0	17.6	17.3	21.9
336	7.9	7.9	7.8	9.4
339	1.4	2.1	1.7	2.5

production of aluminum sheets, plates or extruded products. The concentration in wire drawing and insulating at the state level is about a third greater than at the national level but with this exception; the intra-sectoral employment distributions are not significantly different from the national pattern. Consequently, one can expect the Ohio sector to behave in approximate relationship to the industry as a whole or, conversely, differences in performance are not generally attributable to structural differences betwee state and national industries.

Projections: The Bureau of Labor Statistics base trend projections for 1990, interpolated from the current 1995 estimates, suggest a partial recovery from the 1982 recession for all sectors in the industry group other than sectors 334 and 339. In each case, other than sector 331 (blast furnaces, etc.), the trend estimate of 1990 employment exceeds the 1979 peak by 3 to 9 percent. The major sector, however, is estimated to be 15.3 below the most recent peak level and will continue a secular decline through 1995. The rationale for the radical drop in sectors 334 and 339 is not clear as the

projections constitute a very sharp break with growth patterns from 1972-1983. Employment in sector 334 in 1979 was nearly 18 percent above the 1974 peak and continued to increase through 1981. Similarly, employment in sector 339 in 1979 was 24 percent above the 1974 peak and also continued to increase through 1981. The very sharp break in the trend projection for sector 334 may be attributable to the expected impact of an excess world supply of copper and lead on reclaiming activities. In any event, this sector has very limited importance in Ohio.

Ohio's Share

Ohio's share of national industry employment in Sector 33 has been remarkably stable since 1969. In the aggregate, Ohio's share, which averaged about 13.4 percent between 1974 and 1977, fell to 12.2 percent in 1980 and recovered to 12.5 by the end of 1983. However, this modest decline is accounted for by the greater weight of sectors 331 and 332 in the commodity mix. The recent employment loss in the industry group was initially concentrated in the primary metals sectors. Nearly 80 percent of the net loss prior to 1980 was in sector 331, while sectors 333, 334, 335 and 339 had positive growth from the 1975 trough through 1979. Of the large employment decline from 1979-1983, about 59 percent occurred in sector 331 and 25.6 percent in sector 332. Although all subsectors experienced employment loss in this period, the rate of decline for sectors 331 and 332 was about double the rate for the rest of the sector. The greater weight of these sectors in the Ohio mix distorts the implications of the change in the Ohio share at the aggregate level.

At the three-digit level, only sector 336 demonstrates a geographic shift with a declining share. There is little evidence in these data of a shift of sectoral employment to other areas of the United States. Sectors 333 and 334

show some increase in industry shares over the period. Sectors 332 and 335 are unchanged and sector 339 has been stable since 1977. Sector 331's share was stable from 1965-1977, dropped slightly from 1978 to 1981 and increased from 1981 to 1983, reaching the 1976 level in the latter year. Only sector 336 has experienced a significant loss, dropping from 14.0 percent in the 1969 peak to 12.6 percent in 1979 and 10.4 percent in 1983.

Ohio's Share of National Industry Employment (percent)

SIC	1969	1973	1975	1979	1982	1983
331	15.6	15.9	15.5	14.8	14.8	15.5
332	14.7	14.7	14.3	14.2	14.6	14.2
333	2.0	1.8	3.3	4.6	3.9	4.4
334	--	4.3	8.4	8.9	8.5	8.8
335	9.7	10.3	9.9	9.4	9.2	9.9
336	14.0	13.5	13.1	12.6	10.4	9.7
339	--	--	10.8	8.9	8.3	8.7

Projections of Ohio's share to 1990, combined with the base projections of national industry employment are contained in Table 33.1 below. Both the shift share and regression models used for these projections suggest that four of the seven sectors in this industry group are responding primarily to cyclical factors although in Ohio sector 336 appears to be losing employment to other areas of the United States. These four sectors, 332, 333, 335 and 336, had about 44 percent of the industry employment in 1980 so that nearly half of the primary metals industry will be responsive to economic recovery from the current recession and should experience modest growth through 1990, with employment exceeding the 1979 peak in three sectors and exceeding 1980 levels in four.

Table 33.1

Ohio Primary Metals Industries, 1979-1990

Employment: Actual and Projected

	Actual Employment		Projected Employment-1990		
Sector	1979	1982	(A)	(B)	(C)
331	84,000	58,000	69,400*	71,200	74,700
332	33,900	23,300	35,500*	36,000	36,100
333	3,300	2,300	3,700*	3,600	3,400
334	2,200	1,700	2,400	1,400*	1,300
335	20,700	18,100	23,300	21,400	22,500
336	12,500	8,200	9,700	13,200	10,200
339	2,300	1,800	2,000	1,000*	1,000*
33	158,900	113,400	146,000	147,800	149,200

(A) = Shift share 1965-83

(B) = Constant share 1979

(C) = Constant share 1983

* = Estimates incorporated in occupational matrix projection
(Sector total = 144,200)

SIC 335 and 336 matrix projection estimated by separate regressions:
SIC 335 = 21,900
SIC 336 = 11,300

Table 33.2

Employment: Projected Shares and Growth Rates

Sector	U.S. Growth Rates 1979-90	U.S. Growth Rates 1982-90	Ohio Growth Rates 1979-90	Ohio Growth Rates 1982-90	Ohio Share 1990
331	-15.3%	14.2%	-17.3%	19.7%	14.39%
332	6.3	59.1	4.7	52.4	13.98
333	9.3	34.0	12.1	60.9	4.71
334	-38.9	-28.4	-36.4	-11.6	9.27
335	3.4	23.1	5.8	21.0	9.60
336	5.4	31.5	-9.6	37.8	10.78
339	-65.2	-49.1	-56.5	-44.4	8.62

Tables 33.3 and 33.5 below show employment, growth rates and industry shares from 1972 to 1983 for these three sectors. Apart from cyclical variation, iron and steel foundries (SIC 332) had remarkable stability in employment between 1965 and 1979. The extreme impact of the current recession on the demand for construction machinery, agricultural and transportation equipment has compounded the effect on the demand for foundry products.

The third largest sector in the Ohio industry group, rolling, drawing and extruding of non-ferrous metals, has also had stable employment with modest growth after 1965. Although employment dropped by 17 percent between 1979 and 1982, the 1982 level was nearly identical with that of the cyclical troughs of 1975 and 1965.

Non-ferrous foundries have also had relatively stable employment between 1965 and 1979 but with a 34 percent decline between 1979 and 1983. A persistent decline in Ohio's share reflects growth in other regions and is probably structural since Ohio's employment is highly concentrated in aluminum foundries with primary markets in machinery, household appliances and equipment, and transportation equipment. In general, these three sectors appear to be responding to short-term cyclical factors, in particular the lack of investment in producers' durable goods. They show little evidence of secular decline although their growth potential appears to be modest.

Sector 331: This sector, which provides half of the total employment in the primary metals industry, includes blast furnaces, steel works, and hot rolling mills (SIC 3312); electro-metallurgical products (SIC 3313); steel wire drawing and steel rails and spikes (SIC 3315); cold rolled steel sheet, strip and bars (SIC 3316); and steel pipes and tubes (SIC 3317).

Both at the state and national levels, the blast furnace sector contains about 82 percent of total employment. The employment loss in this sector has

Table 33.3

Employment: Ohio and the United States, 1972-1983
SIC 332: Iron and Steel Foundries

Year	Employment	Absolute Change	Ave. Growth Rate		Empl. Index (1977)		Ohio Share
			Ohio	U.S.	Ohio	U.S.	
1972	31,300	--	--	--	99.9		14.32
1973	34,800	3,500	+11.18	+8.50	107.3		14.67
1974(P)	35,700	900	+2.58	+5.27	113.0		14.30
1975	32,900	-2,800	-7.84	-7.97	104.0		14.32
1976(T)	31,600	-1,300	-3.95	-2.79	101.0		14.15
1977	32,800	1,200	+3.79	+1.03	100.0		14.83
1978(P)	34,300	1,500	+4.57	+2.29	107.0		14.51
1979	33,900	-400	-1.16	+1.06	108.1		14.19
1980	28,200	-5,700	-16.81	-14.40	92.5		13.79
1981	28.500	300	+1.06	-0.54	92.0		14.01
1982	23,300	-5,200	-18.24	-12.03	71.7		14.69
1983(T)	20,400	-2,900	-12.44	-10.79	64.0		14.42
1984*							
1978/74		-1.400	-0.98	-0.87			
1983/76		-11,200	-5.06	-4.80			
1983/78		-13,900	-10.13	-10.19			

Table 33.4

Employment: Ohio and the United States, 1972-1983
SIC 335: Rolling, Drawing and Extruding of Non-Ferrous Metals

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Empl. Index (1977) Ohio	Empl. Index (1977) U.S.	Ohio Share
1972	20,400	--	--	--	102.7		9.98
1973	22,500	2,100	+10.29	+6.80	109.6		10.30
1974(P*)	20,400	-2,100	-9.33	+1.60	111.4		9.19
1975(T*)	17,900	-2,500	-12.25	-18.26	91.1		9.87
1976	20,200	2,300	+12.84	+7.06	97.5		10.40
1977	20,600	400	+1.98	+2.58	100.0		10.34
1978	20,500	-199	-0.48	+4.87	104.9		9.81
1979(P*)	20,700	200	+0.97	+5.56	110.7		9.39
1980	19,600	-1,100	-5.31	-4.22	106.0		9.28
1981	19,800	200	+1.02	-2.42	103.0		9.61
1982	17,100	-2,700	-13.63	-8.40	94.8		9.23
1983(T*)	18,100	1,000	+5.84	-2.92	92.0		9.86
1984*				+4.31	96.0		
1979/74		+300	+0.29	-0.13			
1983/75		+200	+0.14	+0.13			
1983/79		-2,600	-3.14	-4.22			

*National industry and state peaks and troughs.

Table 33.5

Employment: Ohio and the United States, 1972-1983
SIC 336: Non-Ferrous Foundries

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Empl. Index (1977) Ohio	Empl. Index (1977) U.S.	Ohio Share
1972	11,600	--	--	--	104.5		13.90
1973(P*)	12,800	1,200	+10.34	+3.67	115.3		13.50
1974	12,300	-500	-3.90	-0.53	110.8		13.04
1975(T*)	9,900	-2,400	-19.51	-19.62	89.2		13.06
1976	10,600	700	+7.07	+8.97	95.5		12.84
1977	11,100	500	+4.71	+7.99	100.0		12.44
1978	11,900	800	+7.20	+4.15	107.2		12.80
1979(P*)	12,500	600	+5.04	-7.00	112.6		12.57
1980	10,700	-1,800	-14.40	-9.76	96.4		11.92
1981	9,800	-900	-8.41	+1.11	88.3		10.80
1982	8,300	-1,500	-15.30	-12.57	74.8		10.41
1983(T*)	8,200	-100	-1.20	-0.99	73.9		10.43
1984							
1979/73		-300	-0.41	-1.08			
1983/75		-1,700	-2.15	+0.46			
1983/79		4,300	-8.60	-5.23			

*National industry and state peaks and troughs.

been relatively greater than the rest of the industry group and the sector share at the national level fell from nearly 85 percent in 1977 to 81.3 percent in 1983. In 1982, the only year for which data at the 4-digit level are available, Ohio employed about 47,200 workers in this sector--about 14.6 percent of the national industry total.

The residual employment in the sector is shown in the table below. Although in 1982 Ohio had fewer than 2,700 employees in the manufacture of electro-metallurgical products, it had about 27.5 percent of the national industry total. Similarly, the production of cold rolled steel sheets and bars employed 26.5 percent of the industry total but fewer than 3,900 workers.

Ohio Employment

Sector	Reporting Units	Employment	Percent	U.S. Percent
3312	42	47,156	81.4	82.2
3313	10	2,683	4.6	2.5
3315	18	939	1.6	4.8
3316	26	3,870	6.7	3.7
3317	26	3,256	5.6	6.9

The long-term outlook for employment in sector 3312 is of particular concern for manpower and employment policy in Ohio because of its dominant weight in the industry and because a long-term, secular decline is currently exacerbated by a concentrated impact of the current recession. The rate at which this sector is contributing to the pool of displaced workers is obscured by the unique economic conditions currently affecting the durable producer-goods industries.

Table 33.6 below shows Ohio employment in sector 331 from 1972 to 1984. From the employment peak in 1974 to the 1979 peak the sector lost 12,800 employees, an annual loss of 2.58 percent. From the 1975 tough to the 1983 trough it lost 33,800 jobs, an annual rate of 4.97 percent. However, about 95 percent of the loss after 1975 came after the 1979 peak.

In general, change in Ohio's sector employment has been similar to that of the national industy and the state's share of industry employment in 1984 was within one percent of the 1973 peak. Ohio's share did fall consistently from 1973 to a low of 14.34 percent in 1982 but has increased in the last two years to 15.87 percent. This share increase reflects a slight increase in Ohio employment between 1983 and 1984 (2.3 percent) compared to a loss at the national level of 2.1 percent.

At the national level, employment in blast furnaces and steel mills has dropped rather consistently since 1953. The rate of decline was moderate until 1974 but increased rapidly in subsequent years. The data in Table 33.7 show peak year and trough year employment between 1951 and 1984, and the relative change from cyclical peak to preceeding peak and trough to preceeding trough.

The average annual employment loss between the 1951 and 1974 peaks was 0.64 percent. Between the 1974 and 1979 peaks it was exactly twice that rate- an average of 1.28 percent. Similarly, the average loss from the 1952 trough to the 1974 trough was only 0.68 percent, but from 1974 to 1984 it has a eraged 4.44 percent, or 6.5 times the long-term rate. Employment in 1979 was about 20,000 below the peak trend for previous years. In 1984 it was nearly 180,000 below the trough trend and 235,000 below the peak trend. Prior to 1979, peak to trough changes averaged less than 11 percent but in the current recession the employment low in 1984 was 41 percent below the 1979 peak.

Table 33.6

Employment: Ohio and the United States, 1972-1983
SIC 331: Blast Furnaces, Steel Works and Rolling and Finishing Mills

Year	Employment	Absolute Change	Ave. Growth Rate		Empl. Index (1977)		Ohio Share
			Ohio	U.S.	Ohio	U.S.	
1972	89,100	-1,300	--	--	102.9	102.5	15.68
1973	96,300	7,200	+8.08	+6.37	111.2	109.1	15.93
1974(P)	96,800	500	+0.51	+0.81	111.8	110.0	15.88
1975(T)	85,000	-11,800	-12.19	-10.06	98.2	98.9	15.51
1976	86,500	1,500	+1.76	+0.21	99.9	99.1	15.74
1977	86,600	100	+0.11	+0.58	100.0	100.0	15.67
1978	83,700	-2,900	-3.34	+12.66	96.7	101.1	14.96
1979(P)	84,000	300	+0.35	+16.98	97.0	102.9	14.76
1980	72,900	-11,100	-13.21	-10.71	84.2	92.4	14.34
1981	72,600	-300	-0.41	-0.38	83.8	91.3	14.34
1982	58,000	-14,600	-20.11	-21.74	67.0	71.5	14.64
1983(T)	52,100	-5,900	-10.17	-13.41	60.2	61.9	15.19
1984	53,300	+1,200	+2.30	-7.87	61.5	60.6	15.87
1979/74		-12,800	-2.58	-1.33			
1983/75		-33,800	-4.97	-4.68			
1983/79		-31,900	-9.49	-9.93			

Table 33.7

Sector 331
U.S. Employment: Cyclical Peak and Trough, 1951-1984

	Employment (thousands)		Index		
	Peak	Trough	Peak to Peak	Trough to Trough	Peak to Trough
1951	714.4		--		
1952		638.0		--	89.3
1953	726.1		101.6		
1954		645.5		101.2	88.9
1957	719.9		99.1		
1959		587.3		91.0	81.6
1960	651.4		90.5		
1963		589.9		100.4	90.6
1965	657.3		100.9		
1067		635.2		107.6	96.6
1969	643.8		97.9		
1971		573.9		90.3	89.1
1974	609.5		94.7		
1975		548.2		95.2	89.9
1979	570.5		93.6		
1984		335.9		61.1	58.9
Averages:	1951-1984		96.9	92.4	85.6
	1951-1984		97.5	97.6	89.4

In terms of output, the production of pig iron in real terms was only 13 percent below the 1973 peak in 1979 but the 1982 low was 46 percent below the 1 75 trough. The decline in raw steel production from peak to peak was less than 10 percent. The loss from 1975 to 1982 was 36 percent. Shipments of steel mill products reflect the same pattern of gradual decline from 1973 to 1979 and a radical loss thereafter (Table 33.8).

The long-term decline in domestic production is the result of a decline in steel consumption in the domestic market and the growth of foreign capacity. In the decade prior to 1973, steel consumption in the United States increased at an annual rate about 4 percent. In 1973, apparent consumption was 151.0 million tons (ingot equivalents). In the 1979 peak it was 144.1 million tons--an average annual loss of .77 percent. Between 1979 and the 1982 trough, it fell to 88.1 million tons--an annual loss of 13 percent. The OECD estimate for 1984 is 114.7 million tons, or about 80 percent of the 1979 peak.

In the same period, all industrialized nations in the Western world except Canada reduced consumption between 1973 and 1979 with the general slowing of economic growth. All countries in this group had relatively large losses after 1979. Total consumption for all OECD member countries in 1982 was only 78 percent of the 1979 level and remains well below that peak in 1984.

In contrast, steel consumption in the developing countries increased by 65 percent from peak to peak and by another 11 percent to 1984. Their growth was sufficient to more than offset the decline in the industrialized countries until 1979 but not through the current recession. In 1984, steel consumption in the Western world was still 44 million tons below the 1979 level and 29 million below the 1973 peak.[1]

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[1]OECD, The Steel Market in 1983 and the Outlook for 1984.

Table 33.8

Primary Metals - Shipments: Tonnage
Index 1977 = 100

	1972	1973	1975	1979	1982	1983
Pig iron	109.35	123.99	98.28	107.01	53.01	59.90
Iron castings	100.00	111.11	81.05	100.65	53.59	60.78
Raw steel	106.30	120.35	93.06	108.78	59.54	66.56
Steel castings	94.12	111.76	111.76	117.65	58.82	41.18
Steel mill prod.	100.77	122.28	87.82	110.10	65.64	70.09
Semi-finished	122.50	142.50	97.50	137.50	85.00	97.50
Shapes	129.55	161.36	115.91	127.27	77.27	77.27
Plates	101.33	129.33	117.33	120.00	54.67	50.67
Rails	84.21	89.47	105.26	105.26	42.11	47.37
Bars	100.65	118.18	87.01	114.29	61.04	75.97
Pipe & tubing	101.33	121.33	109.33	109.33	66.67	42.67
Wire	125.00	133.33	91.67	100.00	54.17	58.33
Tin mill	95.31	114.06	89.06	98.44	67.19	67.19
Sheets	95.68	118.47	73.86	104.32	66.91	83.45
Exports	145.00	205.00	145.00	140.00	90.00	60.00
Imports	91.71	78.76	62.18	90.67	86.53	88.60

Source: Survey of Current Business.

The declining demand for steel in the industrialized countries is reflected in their steel intensity, the relationship between the steel share of GNP and GNP per capita. Steel consumption tends to grow less rapidly than GNP as economies mature and infrastructure development is completed or its importance in the growth process is diminished. Further, in these more sophisticated economies steel substitutes, particularly plastics and lightweight metals, gain importance. In the developing countries, infrastructure development is a major component of current activity and consequently their steel intensity remains high.[2]

In the short-term these long-term forces have been intensified by the unique characteristics of the current recession in the United States and its impact on the less developed economies. Steel consumption has lagged behind the general recovery because this recovery has not been marked by rapid growth in investment in plant and equipment and, consequently, for steel products. Between 1981 and 1982, expenditures for plant and equipment in manufacturing dropped by 5.6 percent and in the following year by 6.8 percent. The only industrial sector in manufacturing to increase expenditure in both years was electrical machinery and investment in that sector was concentrated in computers, office equipment, and electronic equipment--a sector that is not steel intensive.

In 1983, only the textiles, paper, and rubber industries had positive changes and only the latter had a significant increase. The principal consumer of steel products, transportation equipment, had declining expenditures in both years, averaging 16 percent. The Department of Commerce

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[2]International Iron and Steel Institute, Steel Intensity and GNP Structure, 1974.

reports large planned increases in plant and equipment expenditure in 1984 and 1985,[3] implying an end to the investment lag. The OECD expected an annual increase in steel consumption in 1984 of 8.9 percent for all member countries and 16 percent for the United States.

In the face of declining consumption, Western world steel capacity has increased from about 300 million tons in 1960 to 667 million in 1980. In the OECD countries, crude steel capacity increased by 30 percent between 1968 and 1980 while consumption increased by 10 percent.

Virtually all of the capacity increase has been outside of the United States. By 1982, U.S. crude steel capacity was 139.8 million tons, Japan's capacity was 157.8 million, and western Europe's 242.3 million. The U.S., Japan, and the EEC all had capacity reductions between 1982 and 1984, with small increases in other areas. In total, Western world capacity dropped by 17 million tons, and U.S. capacity fell by the same amount.

The growing imbalance between capacity and consumption has produced very low utilization rates in most countries, and as a consequence, strong pressures to export. In 1982, the utilization rates in the U.S, Japan, and the EEC were 48, 63 and 56 percent respectively. By 1984, rates were estimated to be 71, 66 and 60 percent, increases achieved primarily by capacity reduction.

The U.S. position in the world market has been decimated in the short term by the impact of foreign exchange rates on the exports of its major consumers, the durable goods industries. Data Resources Inc. estimates that between 1981 and 1984, U.S. exports of capital goods dropped by 11 percent in value while imports increased by 76 percent. Imports of consumer durables

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[3] Survey of Current Business, December 1984.

increased by 44 percent and automotive vehicles and parts by 37 percent. While direct imports of iron and steel declined in the period, net imports increased. The OECD estimates that in 1982 net imports were 17.03 million tons or 19.3 percent of domestic consumption. In 1984, they were 23.6 million tons and 20.6 percent of domestic consumption. In those years U.S. exports of crude steel were only 2.3 and 1.6 million tons. U.S. imports in 1982 came primarily from Europe (41 percent) and Japan (32 percent). The developing countries were the source of 15.5 percent and Canada 10.9 percent.

In the long-term, the U.S loss of the world market share and of the domestic market share is based on the loss of its comparative advantage through technological supremacy. The failure of the industry to invest in modern technology at a pace comparable to that of foreign producers has created a cost disadvantage.

In their intensive study of basic steel, Barnett and Schorsch suggest that while the U.S. industry operated in a declining domestic market with adequate or excess capacity and little consequent stimulus to invest, Japan and the developing countries were operating in growing markets and increasing capacity, incorporating advanced technologies, superior locations vis-a vis resources, and alternative strategies. While these countries were creating a steel industry from scratch, investment in the U.S. industry fell from 22 dollars per ton of capacity in 1950 and about 28 dollars in 1969 to 18 dollars in 1978 and 14 in 1980. Further, while Japan and the EEC countries moved rapidly to the basic oxygen furnace, electric furnaces and continuous casting, the U.S. response continues to lag. In 1981, 75 percent of steel production in the EEC and Japan used the basic oxygen process. In the U.S., 61 percent was produced with that technology. Eleven years earlier, the U.S. share was 48 percent, the EEC share 43 percent. In 1981, 100 percent of Japanese steel

and 99 percent of EEC steel was produced with basic oxygen or electric furnaces; the U.S. still produced 12 percent of its output by less efficient processes.

The discrepancy in the use of continuous casting is even greater. In 1981, Japan produced nearly 71 percent of output using this process and the EEC 45 percent. Only 21 percent of U.S. production used it, although that was twice the share in 1976. There are also other factors, economic and institutional, contributing to the comparative advantage of the newcomers, including tax policies, wage rates, supporting infrastructure, trade policies, and, in the case of the Japanese, economies of scale through an average plant capacity nearly three times the U.S. average.

The 1981 U.S. operating costs per net ton shipped estimated at normal operating rates by Barnett and Schorsch were 34 percent higher than Japan's--the major difference stemming from higher labor costs due to greater labor intensity and high rates of compensation. Higher capital costs in Japan partially offset the operating differential and the Japanese advantage in total costs is only 20 percent.

These cost differences are characteristic of integrated mills. The Barnett study emphasizes the fact that U.S. mini-mills are as efficient or more efficient than the Japanese. As a greater share of U.S. production moves to specialized production in mini-mills, the cost differential should decline.

Unfortunately, the U.S industry is caught in a financial trap. High capital costs offer limited returns for investment and labor compensation reflects the comparative advantage of the past. The productivity gains that are necessary to regain some comparative advantage will limit the effects of output increases on employment and the prognosis for the long-term is continued decline. In the short-term, economic recovery from the deep recession should produce modest employment gains.

JUL 13 1987 REC'D

SECTOR 34

Fabricated Metal Products

WORKING DRAFT
July 1985

[For discussion only]

S.C. Kelley
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Employment Forecasting Division
Center for Human Resource Research
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SIC 34

Fabricated Metal Products, except Machinery and Transportation Equipment

This industrial sector includes establishments engaged in fabricating ferrous and nonferrous metal products such as metal cans, tinware, hand tools, cutlery, general hardware, non-electric heating apparatus, fabricated structural products, metal forgings, metal stampings, ordnance and a variety of metal and wire products not elsewhere included.

Industry Structure

The commodity structure of Ohio employment in this sector is generally characteristic of the industry as a whole. Although production is highly diversified among a wide range of products, employment is concentrated in three of the nine subsectors: SIC 344, fabricated structural metal products; SIC 346, metal forgings and stampings; and SIC 349, miscellaneous fabricated metal products. In 1982, these three sectors employed about 71 percent of the industry total (see Figures 34.1 and 34.2).

The major structural difference between the state and national industries is in the greater weight of the metal stampings sector in the Ohio structure and the lesser weight of the structural metal products component. The former exceeded the national weight by 68.7 percent in 1979 and by 78 percent in 1982. The weight of the latter in the Ohio industry was about 27 percent below its weight in the national industry in both years. Table 34.1 shows actual employment for 3-digit sectors in 1979 and 1982 for the state and its distribution if the Ohio structure had been identical to the national industry structure. In that event, employment in Sector 346 (stampings) would have been 21,000 less in 1979 and 16,000 less in 1982 than it actually was. Conversely, employment in Sector 344 (structural metals) would have been 12,000 to 14,000 greater.

Figure 34.1

SIC 34: Fabricated Metal Products - Ohio

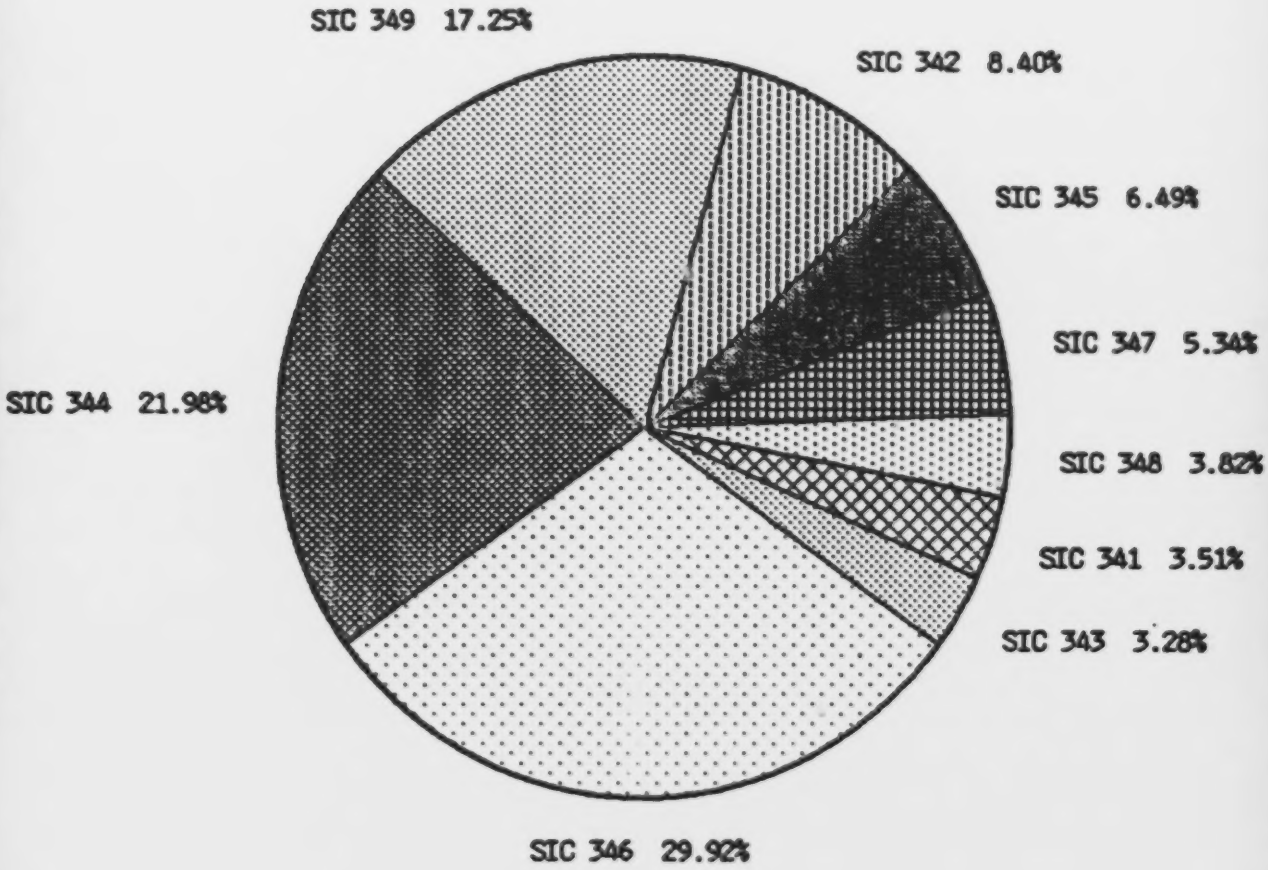

Figure 34.2

SIC 34: Fabricated Metal Products - U.S.

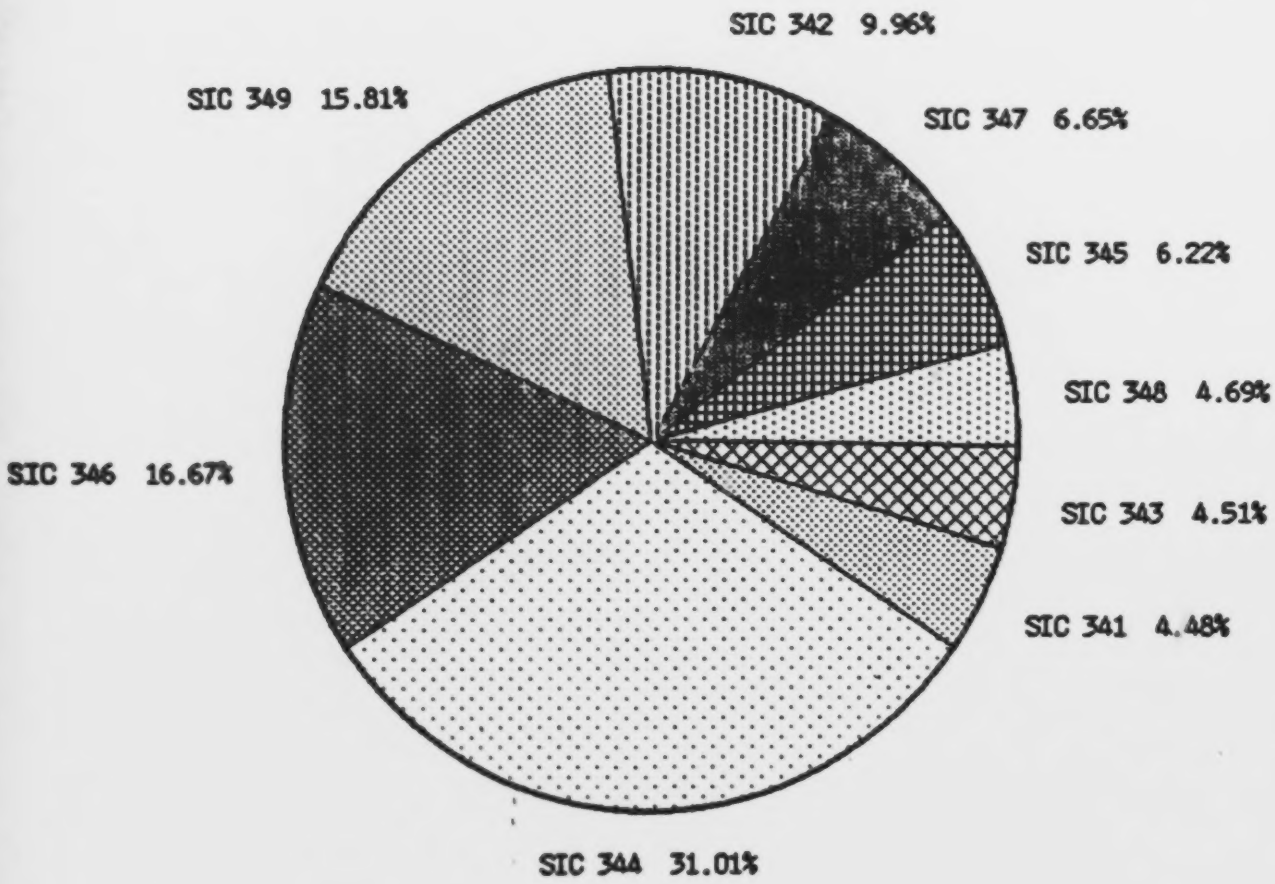

Table 34.1

SIC 34: Ohio Employment, 1979 and 1982
Actual and with National Industry Weights

	1979		1982			
	(1) Actual	(2) U.S. Weight	(3) Actual	(4) U.S. Weight	(5) 1979(1) OH/U.S.	(6) 1982(1) OH/U.S.
341	5,100	8,300	4,500	6,100	.6145	.7500
342	16,100	18,800	11,000	13,300	.8564	.8271
343	7,100	7,700	4,500	5,700	.9221	.7759
344	39,100	53,600	31,600	43,000	.7295	.7349
345	12,800	11,800	9,100	8,500	1.0847	1.0706
346	52,300	31,100	37,900	21,300	1.6871	1.7793
347	7,900	10,900	6,600	9,100	.7248	.7333
348	4,400	6,500	5,000	6,200	.6769	.8065
349	30,800	27,000	24,700	21,600	1.1407	1.1435
34	175,600	175,598	134,900	134,900		

(1) Ratio of Ohio to U.S. weight in Sector 34.

Although these structural differences are not great, they do have an impact on relative national and state growth rates at aggregate levels. Some part of observed differences in aggregate growth rates and changes in the state share of national industry employment is only a reflection of these structural differences. An attempt to estimate the magnitude of this effect in the current recession is described below.

It is also relevant to note that structural differences at less aggregate levels (i.e., 4-digit industry classifications) may be more critical in this respect than the aggregate averages. For example, within Sector 346, subsector 3465 (automotive stampings) employs 52 percent of the sector total at the state level but only 34 percent at the national level. As Sector 346 employs about 29 percent of the industry total, the Ohio industry is very sensitive to fluctuations in automobile production and to imports of automobiles and parts.

Employment

In 1983, Ohio employment in this sector averaged 130,900, nearly 26 percent below the 1979 peak—a loss of 44,700 jobs. In March, 1985, sector employment stood at 137,800—only 5.3 percent above the 1983 annual average and 21.5 percent below the 1979 peak.

This sector, as with other producer durable goods sectors, is normally volatile in general economic fluctuations but the persistence of the current contraction is significantly greater than in any period since the 1930's. The dominant issue for analysis is whether this condition reflects the unique economic conditions of the times—tight monetary policy in recession, high interest rates, growing federal deficit and adverse international terms of trade—or whether it is an episode in long-term structural change.

Table 34.2

Employment by Detailed Industry
Ohio and the United States, 1982

		Employment		Percent		
		Ohio	U.S.	Ohio	U.S.	Ohio/U.S.
3411	Metal cans	3,318	52,901	2.51	3.70	6.27
3412	Metal barrels, drums, pails	1,117	11,826	.84	.83	9.45
341		4,435	64,727	3.35	4.52	6.85
3421	Cutlery	671	13,882	.51	.97	4.83
3423	Hand & edge tools	4,971	41,070	3.76	2.87	12.10
3425	Hand saws & saw blades	365	7,077	.28	.49	5.16
3429	Hardware, n.e.c.	5,005	79,388	3.79	5.55	6.30
342		11,012	141,417	8.33	9.88	7.79
3431	Metal sanitary ware	926	9,542	.70	.67	9.70
3432	Plumbing fittings & brass goods	2,503	23,138	1.89	1.62	10.82
3433	Heating equipment	1,102	28,349	.83	1.98	3.89
343		4,531	61,029	3.42	4.26	7.42
3441	Fabricated structural metal	2,912	88,665	2.20	6.20	3.28
3442	Metal doors, sash & trim	5,332	75,136	4.03	5.25	7.10
3443	Fabricated plate work	11,549	130,056	8.74	9.09	8.88
3444	Sheet metal work	7,782	101,806	5.89	7.11	7.64
3446	Architectural metal work	2,434	28,594	1.84	2.00	8.51
3448	Prefabricated metal buildings	1,047	23,601	.79	1.65	4.44

Table 34.2 (cont.)

Employment by Detailed Industry
Ohio and the United States, 1982

		Employment		Percent		
		Ohio	U.S.	Ohio	U.S.	Ohio/U.S.
3449	Misc. metal work	584	8,278	.44	.58	7.05
344		31,640	456,136	23.93	31.87	6.94
3451	Screw machine products	4,537	41,920	3.43	2.93	10.82
3452	Bolts, nuts, rivits, washers	4,594	48,678	3.47	3.40	9.44
345		9,131	90,598	6.91	6.33	10.08
3462	Iron & steel forgings	5,113	37,257	3.87	2.60	13.72
3463	Nonferrous forgings	1,551	6,048	1.17	.42	25.64
3465	Automotive stampings	19,429	78,013	14.69	5.45	24.89
3466	Crowns & closures	—	5,846	—	.41	—
3469	Metal stampings n.e.c.	11,797	99,301	8.92	6.94	11.88
346		37,881	226,465	28.65	15.82	16.73
3471	Plating & polishing	4,749	65,408	3.59	4.57	7.26
3479	Metal coating	1,829	30,682	1.38	2.14	5.96
347	Coating, engraving, & allied services	6,578	96,090	4.97	6.71	6.85
3482	Small arms ammunition	251	11,706	.19	.82	2.14
3483	Ammunition-other	2,237	27,883	1.69	1.95	8.02
3484	Small arms	N	17,860	N	1.25	—

Table 34.2 (cont.)

Employment by Detailed Industry
Ohio and the United States, 1982

		Employment		Percent		
		Ohio	U.S.	Ohio	U.S.	Ohio/U.S.
3489	Ordnance, n.e.c.	N	8,130	N	.57	--
348		2,488	65,579	1.88	4.58	3.79
3493	Steel springs, except wire	217	5,355	.16	.37	4.05
3494	Valves, pipe fittings	11,077	92,990	8.38	6.50	11.91
3495	Wire springs	1,030	12,166	.78	.85	8.47
3496	Misc. fabricated wire products	3,951	50,033	2.99	3.50	7.90
3497	Metal foil, leaf	484	3,381	.37	.24	14.32
3498	Fabricated pipe & fittings	2,637	26,705	1.99	1.87	9.87
3499	Fabricated metal products, n.e.c.	5,120	38,389	3.87	2.68	13.34
349		24,516	229,019	18.54	16.00	10.70
TOTAL		132,212	1,431,060			

Source: U.S. Department of Labor Bulletin 2215 (January 1984), Vol. II.

The data in Table 34.3 below suggests that the current period is not unique in terms of the amplitude of fluctuation. The average annual change in periods of expansion has been about 6,400 employees. The average annual loss in periods of contraction has been about 11,400, just above the 1979-1983 experience. The greatest annual loss after 1968 was in 1975, a loss of 21,700 jobs. The greatest annual gain was in 1977, an increase of 7,500. The historical pattern of change in this sector has been consistent—precipitous loss in periods of economic contraction and modest but prolonged growth in periods of expansion.

What is unique in the current experience is the failure of the system to recover in 1981 and the renewed rapid decline in 1982. In 1980, the Ohio sector lost 18,400 jobs. It lost only 2,300 in 1981 as the national economy stabilized, but lost another 20,000 in 1982. Whether the deflationary policies of this period, combined with deficit producing fiscal policy has had structural effects sufficient to produce a shift in the long-term growth pattern of the Ohio sector is the critical question involved in long-term employment projections.

Historical data provide little evidence of significant secular decline prior to 1982. Although employment peaked in 1969 at 181.8 thousand, average peak year employment in the 1950's and 1960's was about 7 percent below the average of the 1973 and 1979 peaks. Similarly, average trough year employment in the two earlier decades was about 8 percent less than that of the two troughs in the 1970's and the 1980-81 trough. Ignoring short-term fluctuations due to cyclical factors, the long term annual growth rate was negative but less than one-tenth of one percent.

Structural Change

On the other hand, Ohio data do indicate some structural loss. Between 1973 and 1979, national industry employment increased by 11.1 percent while employment in the Ohio sector was unchanged. As a consequence, Ohio's share of national industry

Table 34.3

Employment Fluctuations - SIC 34, Ohio

1965-1983

Period	Phase	Employment Change	Average Annual Change	Duration (years)
1965-1969	Expansion	+21,800	+5,450	4
1969-1971	Contraction	-21,800	-10,900	2
1971-1973	Expansion	+15,200	+7,700	2
1973-1975	Contraction	-24,200	-12,100	2
1975-1979	Expansion	+24,600	+6,150	4
1979-1983	Contraction	-44,700	-11,175	4

employment dropped from 10.6 percent in 1973 to 10.2 percent in 1979. In absolute terms, Ohio's structural loss to other regions of the United States amounted to about 6,500 potential jobs (see Table 34.4).

This structural shift has accelerated since 1979, with Ohio's share of declining national industry employment dropping from 10.2 to 9.4 percent. The absolute structural loss by 1985 was just under 12,000 jobs or 27 percent of the total employment loss for the period. Structural loss of this type may be a result of industry location or relocation or geographically differentiated growth patterns or it may result from the impact of structural differences in the Ohio and national sectors on short-term growth rates.

Table 34.5 below provides an estimate of structural gain or loss between 1979 and 1982. In this period, Sector 34 lost a total of 40,700 jobs or 23.2 percent of the 1979 annual average. Of that number, 32,100 appear to be attributable to a decline in the demand for the national industry product, although the employment effects may have been increased or partially offset by productivity gains or losses.

Structural loss is estimated to be about 8,600 jobs or 6.38 percent of the 1979 employment. Of that number, 2,400 jobs appear to be a result of differences in the Ohio and national industry structures and consequent weight differentiated growth rates. The residual 6,200 is the apparent loss to other regions of the national economy--a loss of less than 4 percent of the 1979 total.

Nearly 30 percent of the net employment loss due to apparent structural factors in this period was in fabricated structural metal products (SIC 344). Employment in the national industry in 1982 was about 13 percent below the 1979 peak. Employment in the Ohio component dropped nearly 20 percent in the same period and Ohio's share dropped from 7.43 to 6.83 percent (Table 34.6).

This structural loss, which has continued through 1984, is probably attributed

Table 34.4

Fabricated Metal Products (SIC 34)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	162,700	2,700	1.69	—	98.4	98.1	10.5
1973	175,200	12,500	7.68	6.75	106.0	104.7	10.6
1974	172,700	-2,500	-1.43	-0.76	104.5	103.9	10.5
1975	151,000	-21,700	-12.57	-11.00	91.3	92.5	10.4
1976	157,800	6,800	4.50	3.61	95.5	95.8	10.4
1977	165,300	7,500	4.75	4.35	100.0	100.0	10.5
1978	172,100	6,800	4.11	6.14	104.1	106.1	10.3
1979	175,600	3,500	2.03	3.00	106.2	109.3	10.2
1980	157,200	-18,400	-10.48	-5.60	95.1	103.2	9.7
1981	154,900	-2,300	-1.46	-2.68	93.7	100.4	9.8
1982	134,800	-20,000	-12.91	-9.80	81.6	91.5	9.4
1983	130,900	-4,000	-2.97	-3.22	79.2	88.6	9.4
1984*							
1972-83			-1.96	-0.93			
1972-79			1.10	1.56			
1979-83			-7.08	-5.13			

Table 34.5

SIC 34: Structural Change in Employment
1979-1982

SIC	1979 Actual	1982 Actual	1982 Expected[1]	Loss or Gain	Percent Change
341	5,100	4,500	4,100	+400	+7.84
342	16,100	11,000	12,400	-1,400	-8.70
343	7,100	4,500	5,700	-1,200	-16.90
344	39,100	31,600	34,100	-2,500	-6.39
345	12,800	9,100	10,000	-900	-7.03
346	52,300	37,900	38,900	-1,000	-1.91
347	7,900	6,600	7,100	-500	-6.33
348	4,400	5,000	4,500	+500	+11.36
349	30,800	24,700	26,700	-2,000	-6.49
34	175,600	134,900	143,500	-8,600	-6.38

Total loss	40,700	
Demand loss	32,100	
Structural loss	8,600	
Structural difference		2,400[2]
Structural shift		6,200

[1] Change at national industry rates.

[2] Estimated at aggregate sector level by holding growth rates constant and varying sector structure.

Table 34.6

Fabricated Structural Metal Products (SIC 344)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	36,600	-200	-0.54	4.91	97.6	93.9	8.2
1973	39,500	2,900	7.92	8.39	105.3	101.8	8.2
1974	41,000	1,500	3.80	2.13	109.3	104.0	8.3
1975	36,500	-4,500	-10.98	-7.41	97.3	96.3	8.0
1976	35,500	-1,000	-2.74	0.07	94.7	96.3	7.8
1977	37,500	2,000	5.63	3.81	100.0	100.0	7.9
1978	39,300	1,800	4.80	6.56	104.8	106.6	7.8
1979	39,100	-200	-0.51	4.39	104.3	111.2	7.4
1980	37,700	-1,400	-3.58	-1.52	100.5	109.5	7.3
1981	36,000	-1,700	04.51	-3.71	96.0	105.5	7.2
1982	31,600	-4,400	-12.22	-7.32	84.3	97.8	6.8
1983	28,800	-2,800	-8.86	-6.32	-76.8	91.6	6.7
1984*							
1972-83			-2.16	-0.23			
1972-79			0.95	2.45			
1979-83			-7.36	-4.74			

to two characteristics of the Ohio economy. One is that this sector produces, almost exclusively, intermediate goods for the construction sector and the dominant market with that sector is industry building. Further, the sector's markets tend to be local in view of transportation costs. Given the dominance of the durable goods industries in the Ohio economy and in this region and the sharp decline in investment in industrial plant, the impact of the recession on structural metal products has been greater and more persistent than in other areas of the region.

Further, the Ohio sector is heavily weighted (37 percent) in fabricated plate work (boiler shops—SIC 3443). The primary market for this subsector is power generating utilities. This industry in turn has generated little demand for new plants since 1980 due to over-construction in the 1970's and sharp cutbacks in construction of nuclear generating plants for regulatory and financial reasons.[1] Both of these conditions tend to be short-term consequences of cyclical behavior exacerbated by the prolonged recession in the durable goods industries. The impact of current economic policy on the receiving sectors will probably limit growth in the Ohio market for structural metal products relative to the national industry in the long-term. The secondary and tertiary effects on the commercial sector and on the infrastructre development associated with inter-regional population movement will add to these secular restraints.

On the other hand, the Department of Commerce long-term estimate suggests that the industry should be operating at or near the levels of the boom years of the early 1970's by 1987.[2] The BLS projections for 1995 range from 21 percent to 42 percent above 1982, with a base projection of 32.7 percent above 1982 or about 16.5 percent above 1979. Imports have had relatively little direct effect on sector demand, being only about .003 percent (net) in 1983, although the DOC reports recent concern over Japanese and Korean competition on the West Coast.[3] The greater impact on the

Ohio industry is likely to be indirect through the decline of the durable goods industries which constitute its major markets and are particularly vulnerable to foreign competition in the current economic and policy environment.

In sum, the apperent structural loss in this sector would, under normal conditions, be attributable primarily to differences in the commodity mix and markets of the national and Ohio sectors and thus short-term. In the current economic environment, these structural effects may have long-term consequences.

The second largest structural loss in Sector 34 is in subsector 349 (miscellaneous fabricated metal products) with a net loss of 2,000 jobs betwen 1979 and 1982. Between 1973 and 1979, the Ohio sector had a net structural gain of about 5,000 jobs with an annual average growth of 3.26 percent compared to 2.34 percent for the national industry. In that period, Ohio's share of industry employment increased from 10.8 to 11.7 percent. From 1979 to 1983, the sector lost 8,200 jobs and its share fell to 10.2 percent with the share loss equaling 2,000 employees. This structural component amounts to about 6.5 percent of the 1979 employment level and a fourth of the total loss after 1979. It is probably a short-term product of structural difference rather than a structural shift to other areas.

Nearly half of the Ohio component employment is in Sector 3494 (valves and pipe fittings). The primary markets for this subsector include sectors engaged in industrial construction, the manufacture of power generating and oil field equipment, petrochemical processors and exports. In each market, demand for valves and pipe fittings declined through 1983. The Department of Commerce reports that the value of shipments in constant dollars dropped by 9.7 percent between 1982 and 1983, while total employment dropped 11 percent and production worker employment dropped by 12 percent. In 1984 the value of shipments increased by about 6 percent

Table 34.7

Miscellaneous Fabricated Metal Products (SIC 349)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	24,600	-300	-1.20	—	94.3	92.9	11.0
1973	25,500	900	3.66	5.41	97.7	98.0	10.8
1974	26,400	900	3.53	1.45	101.1	99.4	11.0
1975	24,800	-1,600	-6.06	-8.74	95.0	90.7	11.4
1976	26,000	1,200	4.84	5.30	99.6	95.5	11.3
1977	26,100	100	0.38	4.71	100.0	100.0	10.8
1978	27,500	1,400	5.36	6.27	105.4	106.3	10.8
1979	30,800	3,300	12.00	2.81	118.0	109.3	11.7
1980	28,700	-2,100	-6.82	-3.76	110.0	105.2	11.3
1981	28,100	-600	-2.09	1.03	107.7	106.2	11.0
1982	24,700	-3,400	-12.10	-10.56	94.6	95.0	10.8
1983	22,600	-2,100	-8.50	-3.50	86.6	91.7	10.2
1984*							
1972-83			-0.77	-0.12			
1972-79			3.26	2.34			
1979-83			-7.45	-4.29			

while total employment increased by 1.3 percent and production worker employment by 3.1 percent, implying a productivity gain of nearly 5 percent.[4]

Employment Projections

The principal factors affecting employment prospects in the long term appear to be increasing foreign competition and rising labor productivity. The DOC indicates that the value of imports increased 33 percent in 1984 to a level above 8 percent of total new supply in the U.S. At the same time, exports dropped by 6 percent to about 10.8 percent of shipments compared to 13.9 percent two years earlier.[5] The persistence of the hard dollar will continue to encourage the penetration of American markets by foreign producers and incrasing competition for export markets.

The DOC expects continued labor productivity gains in this decade because of "increased use of computerized machine tools, computer aided design and manufacturing and greater efficiency in small lot production."[6] Improvements in both product and process technology should enhance the industries competitive position in both domestic and foreign markets.

The BLS projections for employment in 1995 in this subsector range from 308,900 to 337,500. Their base projection of 333,200 is 45.69 percent above 1982 and 26.4 percent above 1979. A constant 1979 share would imply Ohio employment of 39,000, while a constant 1982 share would be 36,000. The lower value is about 17 percent above the 1979 peak and about 46 percent above the 1982 low.

The largest sectoral component of Sector 34, metal forgings and stampings, gives little evidence of recent structural loss. The maximum estimate is about 1,000 jobs since 1979 or 1.9 percent of that year's total employment. Between 1973 and 1977, the sector had a positive structural gain as its share of national industry employment increased from 16.2 to 17.5. In 1978 and 1979, it fell to 17.2 percent and

to a low 16.4 percent in 1980. In 1981, it increased to 17.6 percent—an all time high—and fell to 16.8 in 1982 and 1983 (Table 34.8).

Structural change in this subsector appears to be short term and cyclical, influenced primarily by the demand for automotive stampings—its dominant product. From 1972 to 1979, it had an annual average rate of growth in employment of 2.47 percent against a rate of .59 percent for the industry. Between 1979 and 1983 its average loss was 6.95 percent against 6.5 percent for the industry. Recovery for the current recession began at both the state and national levels in 1983 and is continuing in 1985.

Between 1982 and 1984, the constant dollar value of automotive stamping shipments increased by 72.5 percent and total employment grew by 26.6 percent. The value of imports increased from 124.33 to 210 million but remained at 1.4 percent of total supply given the large increase in supply. Exports also grew from 1.097 billion to 1.3 billion but failed to keep up with the increase in shipments, falling from 12.5 percent to 8.8 percent.

Although foreign competition in automotive stampings is not as severe as in the case of motor vehicle parts and accessories, the increase in outsourcing—again, influenced by adverse terms of trade—does threaten growth of the sector as, of course, does the growth of automobile imports.

The BLS employment projections for Sector 346 are extremely modest, ranging from 235,500 to 258,200 in 1995. The base projection is 251,000 or 11.55 percent above 1982 and 18 percent below 1979. At the 1982 share, that would imply an employment in 1995 of 42,500, near the 1980 level but about 19 percent below the 1978 and 1979 peaks. As the DOC suggests, it is extremely difficult to project employment in this area because of the institutional changes now taking place. The BLS projections for automotive stampings do appear to be conservative.

Table 34.8

Metal Forgings and Stampings (SIC 346)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	44,100	2,600	6.27	—	87.2	101.0	15.1
1973	50,100	6,000	13.61	5.89	99.0	106.9	16.2
1974	46,800	-3,300	-6.59	-6.00	92.5	100.5	16.1
1975	43,300	-3,500	-7.48	-14.55	85.6	85.9	17.4
1976	48,100	4,800	11.09	10.54	95.1	94.9	17.5
1977	50,600	2,500	5.20	5.33	100.0	100.0	17.5
1978	52,300	1,700	3.36	5.08	103.4	105.1	17.2
1979	52,300	0	-0.00	0.16	103.4	105.3	17.2
1980	43,200	-9,100	-17.40	-13.63	85.4	90.9	16.4
1981	44,900	1,700	3.94	03.04	88.7	88.1	17.6
1982	37,900	-7,000	-15.59	-11.76	74.9	77.8	16.8
1983	39,200	1,300	3.43	3.42	77.5	80.5	16.8
1984*							
1972-83			-1.07	-2.05			
1972-79			2.47	0.59			
1979-83			-6.95	-6.50			

Of the smaller components of Sector 34, two had modest employment gains from structural changes while four had losses ranging from 500 to 1,400 potential jobs. In the aggregate the net loss was about 3,100 jobs (see Tables 34.10-34.15 below).

Table 34.9 below provides nine estimates of 1995 employment for three-digit sectors and for the total sector. All estimates are based on the Bureau of Labor Statistics low, base and high projections for the national industry. The initial model is a shift share model based in the time series considered most relevant for each 3-digit sector. The second series assumes the state's 1979 share of national industry employment is constant through 1995, and the third series assumes a constant share at the 1982 level.

The shift share model has a number of limitations—most important is that the time series data that it uses is limited in several sectors due to industrial classification changes in the early 1970's. Further the share regression is linear and short-term structural shifts are exaggerated over the long period of the projection. In those sectors with a limited data base, the constant share models may produce more realistic results.

As the data indicate, the difference between the high and low assumptions underlying the BLS projections for the U.S amounts to about 16,000 jobs in all models with the base projection being about 10,000 above the low estimate. The base estimate ranges from 155,500 in the shift share model to 182,300 in the constant share 79 model. The more conservative and probably the most realistic estimate is the 169,700 derived from the constant share 82 version. This estimate compares favorably with a Department of Commerce unpublished projection of 161,000 but is considerably higher than the most recent Chase Econometrics estimate for 1993 of

Table 34.9

Sector 34: Ohio Employment Projections—1995
Three Models

	Low	Base	High	Share
SIC 341				
Shift Share 1975-83	4,700	4,800	5,000	.0970
Constant Share 1979	4,100	4,100	4,300	.0660
Constant Share 1982	4,000	4,000	4,200	.0643
SIC 342				
Shift Share 1965-84	11,800	12,000	12,200	.0599
Constant Share 1979	17,200	17,400	17,700	.0871
Constant Share 1982	15,800	15,900	16,300	.0800
SIC 343				
Shift Share 1975-84	3,000	3,100	3,500	.0392
Constant Share 1979	7,300	7,300	8,300	.0939
Constant Share 1982	5,200	5,300	6,000	.0679
SIC 344				
Shift Share 1965-84	30,500	33,600	36,000	.0547
Constant Share 1979	41,500	45,600	48,900	.0743
Constant Share 1982	38,200	42,000	45,000	.0684
SIC 345				
Shift Share 1965-84	7,200	7,400	7,400	.0614
Constant Share 1979	12,900	13,200	13,300	.1102
Constant Share 1982	11,400	11,700	11,900	.0979
SIC 346				
Shift Share 1972-84	43,100	46,000	47,300	.1831
Constant Share 1979	40,500	43,100	44,400	.1718
Constant Share 1982	39,700	42,300	43,500	.1684
SIC 347				
Shift Share 1975-83	4,400	4,800	4,900	.0518
Constant Share 1979	6,200	6,700	6,800	.0726
Constant Share 1982	6,000	6,500	6,600	.0707
SIC 348				
Shift Share 1975-83	9,000	8,700	9,300	.1023
Constant Share 1979	6,100	5,900	6,200	.0689
Constant Share 1982	6,200	6,000	6,300	.0700
SIC 349				
Shift Share 1972-83	32,600	35,100	35,600	.1054
Constant Share 1979	36,200	39,000	39,500	.1171
Constant Share 1982	33,400	36,000	36,500	.1080

Table 34.9 (cont.)

Sector 34: Ohio Employment Projections--1995
Three Models

	Low	Base	High	Share
SIC 34 (Total)				
Shift Share	146,300	155,500	161,200	.0846
Constant Share 1979	172,000	182,300	189,400	.0994
Constant Share 1982	159,900	169,700	176,300	.0886

Table 34.10

Metal Cans and Shipping Containers (SIC 341)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1975	4,900				92.5	101.7	6.20
1976	5,000	100	2.04	-1.49	94.3	100.2	6.20
1977	5,300	300	6.00	-0.20	100.0	100.0	6.80
1978	5,200	-100	-1.89	1.68	98.1	101.7	6.60
1979 (P)	5,100	-100	-1.92	2.66	96.2	104.4	6.30
1980	4,700	-400	-7.84	-4.70	88.7	99.5	6.10
1981	4,600	-100	-2.13	-7.26	86.8	92.3	6.40
1982	4,500	-100	-2.17	-6.85	84.8	85.9	6.80
1983 (T)	4,600	100	2.22	6.01	86.8	80.8	7.30
1984*							

Table 34.11

Cutlery, Hand Tools, & Hardware (SIC 342)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	14,400	300	2.13	8.41	90.6	91.0	9.0
1973	15,800	1,400	9.72	9.25	99.4	99.5	9.0
1974	15,300	-500	-3.16	-0.54	96.2	98.9	8.8
1975	13,800	-1,500	-9.80	-12.29	86.8	86.8	9.0
1976	15,000	1,200	8.70	9.15	94.3	94.7	9.0
1977	15,900	900	6.00	5.59	100.0	100.0	9.0
1978	16,400	500	3.14	3.68	103.1	103.7	9.0
1979	16,100	-300	-1.83	0.98	101.3	104.7	8.7
1980	13,900	-2,200	-13.66	-8.82	87.4	95.5	8.2
1981	13,100	-800	-5.76	0.42	82.4	95.1	7.8
1982	11,000	-2,100	-16.03	-18.17	69.2	77.8	8.0
1983	11,000	0	-0.00	1.24	69.2	78.8	7.9
1984*							
1972-83			-2.42	-1.31			
1972-79			1.61	2.02			
1979-83			-9.08	-6.87			

Table 34.12

Plumbing and Heating Equipment, except Electrical (SIC 343)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1975	5,500				88.7	88.6	9.1
1976	5,700	200	3.64	4.47	91.9	92.6	9.0
1977	6,200	500	8.77	8.00	100.0	100.0	9.1
1978	6,900	700	11.29	8.63	111.3	108.6	9.3
1979	7,100	200	2.90	1.75	114.5	110.5	9.4
1980	5,900	-1,200	-16.90	-8.20	95.2	101.5	8.5
1981	5,100	-800	-13.56	-2.02	82.3	99.4	7.5
1982	4,500	-600	-11.76	-2.50	72.6	96.9	6.8
1983	4,300	-200	-4.44	-4.98	69.4	92.1	6.8
1984*							

Table 34.13

Screw Machine Products, Bolts, Nuts (SIC 345)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate		Emp. Index (1977)		Ohio Share
			Ohio	U.S.	Ohio	U.S.	
1975	11,200				91.8	92.8	12.0
1976	11,600	400	3.57	2.51	95.1	95.1	12.2
1977	12,200	600	5.17	5.17	100.0	100.0	12.2
1978	12,400	200	1.64	9.56	101.6	109.6	11.3
1979	12,800	400	3.23	5.64	104.9	115.7	11.0
1980	11,100	-1,700	-13.28	-6.37	91.0	108.4	10.2
1981	10,700	-400	-3.60	-5.33	87.7	102.6	10.4
1982	9,100	-1,600	-14.95	-10.87	74.6	91.4	9.9
1983	8,500	-600	-6.59	-5.45	69.7	86.5	9.8
1984*							

Table 34.14

Coating, Engraving, & Allied Services (SIC 347)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1975	7,100				94.7	90.0	8.4
1976	7,000	-100	-1.41	6.66	93.3	96.0	7.8
1977	7,500	500	7.14	4.14	100.0	100.0	8.0
1978	8,100	600	8.00	10.60	108.0	110.6	7.8
1979	7,900	-200	-2.47	5.32	105.3	116.5	7.3
1980	7,200	-700	-8.86	-0.28	96.0	116.2	6.6
1981	7,400	200	2.78	-4.52	98.7	110.9	7.1
1982	6,600	-800	-10.81	-9.94	88.0	99.9	7.1
1983	7,000	400	6.06	-0.43	93.3	99.5	7.5
1984*							

Table 34.15

Ordnance and Accessories (SIC 348)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1975	3,900				97.5	115.3	5.9
1976	3,900	0	-0.00	-13.41	97.5	99.9	6.8
1977	4,000	100	2.56	0.13	100.0	100.0	6.9
1978	4,000	0	-0.00	4.86	100.0	104.9	6.6
1979	4,400	400	10.00	5.79	110.0	110.9	6.9
1980	4,800	400	9.09	-4.85	120.0	105.6	7.9
1981	5,000	200	4.17	-0.99	125.0	104.5	8.3
1982	5,000	0	-0.00	18.60	125.0	124.0	7.0
1983	5,000	0	-0.00	-8.26	125.0	113.7	7.6
1984*							

148,800 or 149,800 if extrapolated to 1995. This is, in our view, a quite conservative estimate. It assumes an increase of 12.1 percent over the 1982 low, and 4.2 percent over 1984 but 15 percent below 1979. In contrast, the BLS base projection for the U.S. is 27.17 percent above 1982 and 6.8 percent above the 1979 high.

FOOTNOTES

[1]U.S. Department of Commerce, 1985 Industrial Outlook.

[2]Ibid.

[3]Ibid.

[4]Ibid.

[5]Ibid.

[6]Ibid.

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SECTOR 35

Machinery, Except Electrical

Ohio Employment: 1965-1990

WORKING DRAFT
February 1985

[For discussion only]

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Employment Analysis and Projections

Sector 35: Machinery, Except Electrical

This sector includes establishments engaged in manufacturing engines and equipment (SIC 352), construction, mining and materials handling machinery and equipment (SIC 353), metalworking machinery and equipment (SIC 354), special industrial machinery (SIC 355), general industrial machinery and equipment (SIC 356), office, computing and accounting machines (SIC 357), and refrigeration and service industry machinery (SIC 358).

The machinery industry is a major component of the durable goods sector. At the national level the industry employed 2,498,300 persons in 1981, its peak year. In Ohio, the sector employed 223,500 in 1979, its most recent peak, down slightly from its period peak of 227,700 in 1974.

Between 1972 and 1979, the national industry had a substantial growth in employment, averaging 4.5 percent annually, with the most rapid growth in the period 1976 to 1979. In 1981 and 1981, employment remained almost constant in the aggregate as growth in some sectors was offset by declines in others. In 1982 and 1983 it dropped by 460,000, a decline of 18 percent in two years (Table 35.1).

The Ohio sector moved in conjunction with the national industry but with a much lower growth rate through 1979, averaging less than one percent annually. Further, the Ohio sector was much more volatile than the national sector in response to cyclical variation—in particular the recession years of 1975 and 1976. Since 1979 the sector has had an average annual loss of 7.9 percent, almost twice the national rate. In absolute numbers, the sector lost 70,400 jobs in the years 1980-1983. Sixty

Table 35.1

Machinery, Except Electrical (SIC 35)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	205,100	+5100	+2.55	(1)	97.3	86.9	10.85
1973	214,900	+14,800	+7.21	+10.58	104.4	96.1	10.52
1974 (P)	227,700	+7,800	+3.54	+5.70	108.1	101.5	10.31
1975	207,700	-20,000	-8.78	-6.84	98.6	94.6	10.10
1976 (T)	205,900	-1,800	-0.86	+0.40	97.7	95.0	9.97
1977	210,700	+4,800	+2.33	+5.30	100.0	100.0	9.69
1978	216,700	+6,000	+2.84	+6.93	102.8	106.9	9.31
1979 (P)	223,500	+6,800	+3.13	+6.85	106.1	114.3	8.99
1980	213,800	-9,700	-4.34	+0.37	101.5	114.7	8.57
1981	204,200	-9,600	-4.49	+0.17	96.9	114.9	8.17
1982	176,700	-27,500	-13.46	-10.18	83.9	103.2	7.87
1983 (T)	153,100	-23,600	-13.35	-9.16	72.7	93.7	7.51
1984*							
1972-83			-2.30	+ .71			
1972-79			+ .82	+4.30			
1979-83			-7.88	-4.50			

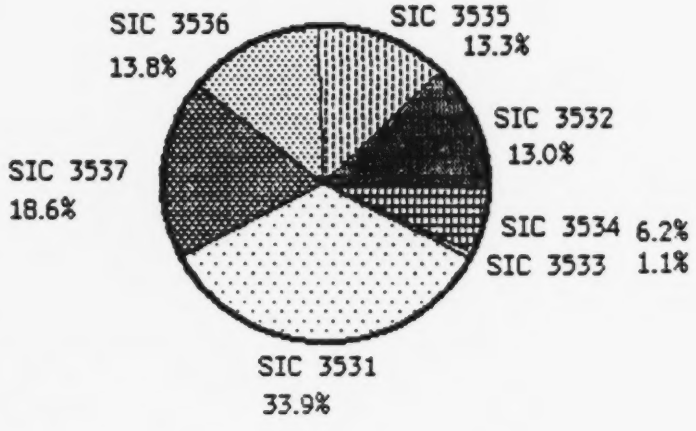
thousand or 85 percent of that loss was in 1982 and 1983. As a consequence, the Ohio share of national industry employment has dropped from about 10.3 percent in the peak year 1974 to about 9 percent in the 1979 peak and 7.5 percent in the 1983 recession. The recent growth patterns at the national and state levels are conditioned primarily by the slowing of investment expenditure due to the demand recession after 1979 and the extremely high interest rates that accompanied or contributed to it, and to the loss of export markets and an increase in import substitution that occurred in response to foreign exchange imbalances and worldwide recession. The latter conditions have been particularly marked since 1981.

The differences between the national and state growth patterns are explained in large part by differences in the impact of these forces on the national and state sectors due to differences in the commodity structure of the two sectors and in differentiated growth rates of their subsectors (see Figure 35.1). As an example, in 1983 21 percent of the national sector employment was in SIC 357 (office, computing and accounting machines), a sector with a very high rate of growth through the entire period 1972-1983. Between 1972 and 1979, employment increased by 65 percent in the subsector as a whole and by 89 percent in the computing component. Between 1979 and 1983, employment increased by 20.5 percent in the aggregate and 28.5 percent for the subsector. In 1983, employment for the total machinery sector (SIC 35) was only 149,000 above the 1972 level. In the office, computing and accounting machine subsector it exceeded the 1979 level by 240,400 and in the computing machinery component of that subsector by 248,000.

Figure 35.1

Employment--Construction, Mining and Materials Handling Equipment

Ohio, 1982



United States, 1982

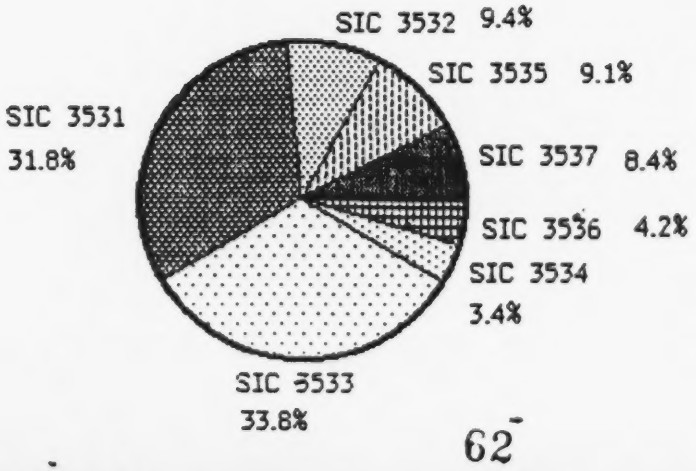


Table 35.2

SIC 35: Machinery, except Electrical
Employment by Subsector, 1983

SIC		Number		Percent		Ohio
		Ohio	U.S.	Ohio	U.S.	U.S.
351	Engines & Turbines	4,622	115,530	4.00	2.62	5.13
352	Farm & Garden Machinery & Equipment	3,131	124,214	2.52	1.78	5.52
353	Construction, Mining & Materials Handling Machinery	21,213	335,746	6.32	12.04	14.91
354	Metalworking Machinery & Equipment	46,725	316,636	14.76	26.51	14.07
355	Special Industrial Machinery, except 354	18,260	175,127	10.43	10.36	7.78
356	General Industrial Machinery & Equipment	34,372	288,434	11.92	19.50	12.81
357	Office, Computing & Accounting Machines	13,345	475,305	2.81	7.57	21.11
358	Refrigeration & Service Industry Machinery	15,947	161,039	9.90	9.05	7.15
359	Miscellaneous Machinery	18,613	259,084	7.18	10.56	11.51
	TOTAL	176,228	2,251,115	7.83	100.00	100.00

In contrast to the national ratio of 21 percent, only 2.8 percent of Ohio's Sector 35 employment was in this subsector and only a fourth of that was in the computing machinery component. Obviously, this structural difference alone accounts for much of the difference between the Ohio and national growth experiences. Much of the residual is a product of the greater weight of industrial machinery in the Ohio product mix, with its greater sensitivity to cyclical variation in the national economy. Further, differences in the component structure at more disaggregate levels (4-digit SIC) also contribute to the aggregate difference and are discussed below.

SIC 351: Engines and Turbines. This sector contains two subsectors, sector 3511 (turbines and turbine generator sets) and 3519 (internal combustion engines, nec). The latter does not include aircraft engines or automotive gasoline engines. It is not a major area of employment in Sector 35 (non-elelctrical machinery). Ohio'e employment in 1982 was only 4,700 persons or 2.6 percent of the sector 35 total and 4.1 percent of national industry employment in sector 351.

Ohio employment is concentrated in subsector 3519. About 96 percent of the sector total is in this subsector, compared to 70 percent of national industry employment. At the national level, employment reached a peak of 145,100 in 1979, dropped to 114,600 by 1982 and to 103,900 in 1983 (Table 35.3). Although nearly all of this loss was in sector 3519, Ohio employment in the sector increased from 4,300 in 1979 to 4,800 in 1981 and 4,700 in 1982 before falling to 3,400 in 1983, a reflection of structural difference. The Ohio component had an average annual growth of 4.49 percent for the period 1972-1983 compared to 1.2 percent for the national total and an average of 11.3 percent versus 3.8 percent from 1972-1979.

Table 35.3

Engines and Turbines (SIC 351)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	2,400	—	—	—	64.9	91.5	2.09
1973	2,400	0	0.00	6.13	64.9	97.0	1.97
1974 (P)	2,500	100	4.16	4.00	67.6	101.0	1.97
1975	3,500	1,000	40.00	-5.51	94.6	95.4	2.92
1976 (T)	3,500	0	0.00	0.85	94.6	96.2	2.90
1977	3,700	200	5.71	3.62	100.0	100.0	2.96
1978	4,300	600	16.21	7.92	116.2	109.2	3.18
1979 (P)	4,300	0	0.00	7.86	116.2	115.8	2.95
1980	4,000	-300	-6.97	-6.94	108.1	107.9	2.95
1981	4,800	800	20.00	-1.47	129.7	106.2	3.60
1982	4,700	-100	-2.08	-13.87	127.0	91.5	4.09
1983 (T)	3,400	-1,300	-27.65	-13.24	91.9	82.9	3.41
1984*							
1972-83			4.49	+1.20			
1972-79			+11.31	+3.80			
1979-83			-5.23	-7.10			

Its loss after 1979 was also less than the national rate but concentrated in 1983. As a consequence, Ohio's share of national industry employment, which had held at approximately 3 percent between 1975 and 1980, increased to 4.09 percent in 1982, dropping to 3.4 percent in 1983. The sharp decline in 1983, a drop of 27.7 percent, is a result of the general decline in demand for engine-using finished goods and in the demand for diesel automotive engines.

The small size and structural differences of this subsector relative to the industry as a whole limits the level of confidence attached to long-term forecasts. The Bureau of Labor Statistics projections for the national economy is a compound annual growth of .9 percent after 1979 or 2.9 percent between 1982 and 1990. Their estimate for subsector 3519 in the 1984 Industrial Outlook is an annual increase of 6 percent through 1988.

There is no apparent reason for an assumption that the Ohio component of this sector will not perform as well as the national industry. At the BLS rates, Ohio employment in the sector should be between 4,700 and 5,900 in 1990. A trough-to-trough shift share model (1975-1983) produces a 1990 estimate of 7,100 on the BLS base projection while constant share projections from 1979, 1982 and 1983 produce estimates of 4,700, 6,600 and 5,500 respectively. The projection used in the current matrix analysis for 1990 is 5,200; 21 percent over 1979 but only 11 percent over 1982.

SIC 352: Farm and Garden Machinery and Equipment. In 1979 this subsector of Sector 35 employed only 2.4 percent of the sector total. In 1982 its share was 2.5 percent while the number of employees dropped from 5,300 to 3,200. Slightly more than half (54 percent) of 1982 employment was in farm machinery and equipment (SIC 3523) and the residual in sector

3524 (lawn and garden equipment).

The depressed condition of the agricultural sector and the cyclical nature of the demand for lawn and garden equipment produced an historic low employment of 3,100, a loss of 2,200 employees since 1979. Between 1972 and 1979, employment fluctuated with the general business cycle in a range from 4,000 (1975) to 5,300 (1979). It averaged 4,700 over the period.

The average annual rate of growth between 1972 and 1979 was a positive 1.8 percent for Ohio compared to 5 percent for the nation. After 1979, these rates were a negative 10.4 percent and 10.2 percent respectively. Almost half of the Ohio loss occurred in 1980, the initial year of the recession, reflecting the greater weight of lawn and garden machinery in the commodity mix. The magnitude of the decline after 1979 at both state and national levels is a result of the diverse factors affecting the agricultural sector, including low farm prices, high interest rates for agricultural credit, poor crop conditions and export markets.

The Ohio share of national industry employment has dropped from 3.48 percent in 1972 to 2.18 percent in 1981, recovering to 2.42 percent in 1983. This change does not appear to reflect a long-term trend. Ohio's employment in this sector has been more sensitive to cyclical fluctuations than the industry average. This volatility is probably due to the small scale of the Ohio sector and its greater product homogeneity. Its share was greatest in the peak years 1973 and 1979 in national employment and lowest in the trough years 1975 and 1981 (Table 35.4).

The BLS base projection for this sector suggests that employment at the national level will be about 4 percent below the 1979 level in 1990, in contrast to their original projection of a 23 percent gain. The conservative estimate apparently assumes a decline in the demand for

Table 35.4

Farm and Garden Machinery and Equipment (SIC 352)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Avg. Growth Rate Ohio	Avg. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	4,700	—	—	—	104.4	80.6	3.48
1973	5,100	400	8.51	13.80	113.3	91.7	3.31
1974 (P)	5,100	0	0.00	10.14	113.3	101.0	3.01
1975	4,000	-1,100	-21.56	-4.96	88.9	96.0	2.48
1976 (T)	4,200	200	5.00	0.78	93.3	96.8	2.59
1977	4,500	300	7.14	3.29	100.0	100.0	2.68
1978	4,700	200	4.44	-2.80	104.4	98.5	2.88
1979 (P)	5,300	600	12.76	11.37	117.8	108.8	2.92
1980	4,300	-1,000	-18.86	-6.23	95.6	101.0	2.53
1981	3,600	-700	-16.27	-2.94	80.0	92.7	2.18
1982	3,200	-400	-11.11	-20.67	71.1	73.3	2.44
1983 (T)	3,100	-100	-3.12	-2.14	68.9	64.5	2.42
1984*							
1972-83			-3.01	-0.03			
1972-79			+1.82	+5.00			
1979-83			-10.38	-10.18			

agricultural machinery due to the economic conditions of the agricultural sector, its export markets and a reduction in the number of farm units. It does not appear to be attributable to import substitutes as imports have declined in both real and nominal terms since 1979 while exports have continued to grow since 1970, increasing by 68 percent in current dollar values between 1978 and 1981.

Further, there seems to be no hard basis for assuming significant gains in productivity. In 1980 output per employee hour was 96.3 percent of 1977 levels and 2 index points above the 1973 level. Although productivity increased at an average rate of 2.45 percent between 1960 and 1973, it has had very limited gains in the last decade.

A dominant factor in the more conservative BLS projections is the large inventory of farm equipment in the hands of dealers as a consequence of the coincidence of the negative forces on demand noted earlier and the potential for import competition for both machinery and agricultural products arising from the continued and increasing imbalance in exchange rates. Although imports provided only 12.3 percent of new supply in 1983 they are a growing source of small tractors, about three-fourths of the tractor market.

A shift share projection based on the period 1965-1983 against the BLS base projection for the industry would estimate Ohio employment in 1990 to be slightly above 3,800. Constant share projections for the past seven years range from 3,800 (1981) to 5,100 (1979). The 1982 share of 2.44 percent projects to 4,300 and is accepted in this study as the most reasonable estimate.

SIC 353: Construction, Mining and Materials Handling Machinery and Equipment. Between 1965 and 1979 Ohio employment in this subsector

averaged 28,900 with limited variance. The period average was about 95 percent of the peak level in 1974 and only 107 percent of the period low in 1972. Further, employment in the cyclical peaks of 1969, 1974 and 1979 fell within a range of 600 workers. This remarkable stability ended with a loss of 2,800 jobs in 1980, followed by an accelerated loss of 4,400 and 4,500 employees in 1982 and 1983. In the latter year, employment averaged 16,800, fifty-seven percent of the 1979 level and 70 percent of that loss occurred in 1980 and 1982 (Table 35.5).

This pattern is not completely consistent throughout the sector. As a generalization, all four-digit subsectors experienced accelerated decline in the recession trough. Some, however, experienced growth or limited loss through 1981, in particular oil field machinery, mining machinery and materials handling equipment. These intra-sectoral differences combined with extensive differences in the commodity structure of the Ohio and national sectors have produced a sharp decline in Ohio's share of national industry employment (see Figure 35.1). In 1982, employment in the manufacture of oil field machinery at the national level was nearly 34 percent of the sector total but only 1.1 percent at the state level. In contrast to all other subsectors in sector 351, employment in that subsector increased by 33 percent between 1979 and 1982 as a result of the impact of deregulation on domestic drilling activities and other market conditions. Conversely, 52 percent of Ohio's employment in the sector was in construction machinery and industrial trucks and tractors. Both subsectors have had constant losses since 1979.

In the aggregate, Ohio's share of national industry employment fell from 8.4 percent in 1977 to 6.4 percent in 1981 and 1982, although it increased to 6.7 percent in 1983. However, if Ohio employment is compared

Table 35.5

Construction, Mining and Materials Handling
Machinery and Equipment (SIC 353)

Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	26,800	—	—	—	90.5	84.1	9.12
1973	28,500	1,700	6.34	10.15	96.3	92.6	8.80
1974 (P)	30,500	2,000	7.01	6.35	103.0	98.5	8.86
1975	29,600	-900	-2.95	-0.76	100.0	97.8	8.66
1976 (T)	29,000	-600	-2.02	-1.68	98.0	96.1	8.63
1977	29,600	600	2.06	4.96	100.0	100.0	8.39
1978	29,900	300	1.01	6.69	101.0	106.7	7.95
1979 (P)	29,400	-500	-1.67	2.12	99.3	109.6	7.65
1980	26,600	-2,800	-9.52	2.31	89.9	111.5	6.77
1981	25,700	-900	-3.38	1.67	86.8	114.9	6.43
1982	21,300	-4,400	-17.12	-14.66	72.0	96.0	6.24
1983 (T)	16,800	-4,500	-21.12	-22.38	56.8	71.6	6.34
1984*							
1972-83			-3.76	-0.48			
1972-79			+1.39	+4.33			
1979-83			-10.73	-8.65			

to the national industry, excluding oil field machinery, the state's share fell from 10.5 in 1977 and 9.9 in 1979 to 9.1 in 1981 and rose to 9.6 in 1982. At least since 1978, changes in Ohio's share appear to be mainly a function of differences in commodity composition and short-term fluctuations rather than domestic relocation of industry.

Adequate time-series data for 4-digit sectors are not available for Ohio. The previous analysis suggests that Ohio's subsectors have behaved much like their national counterparts. At the national level employment in construction machinery in 1983 was 50.2 percent of the 1978 peak and 35 percentage points below the 1981 level. The accelerated decline after 1981 appears to be a result of a sharp drop in public highway construction and a radical decline in exports. Approximately 20 percent of the shipments of this industry were used in public construction and 40 percent went to exports. The remainder was equally distributed between building construction and surface mining. The completion of the interstate highway system has left large stocks of equipment in the hands of contractors, depressing future demand. Further, exports which had increased dramatically from 1972 to 1983 fell from 6.3 billion in 1981 to 4.0 billion in 1982 and approximately 2.6 billion in 1983. This loss is a product of the impact of the recession and the loss of oil revenues on the investment programs of less-developed countries, enhanced by international exchange rates (see 1984 U.S. Industrial Outlook.)

Imports of construction machinery in 1982 were less than 8 percent of total shipments and fell to 6 percent in 1983. The BLS believes, however, that foreign competition in this area will increase significantly in the long term. If foreign exchange rates continue at their current level, U.S. producers will lose an important share of both domestic and export markets.

The increasing need for maintenance of highways and bridges and the construction of water and sewer systems, with continued growth of residential and commercial construction should produce a potential demand for construction equipment in the long term. This demand, however, may be dampened by the attempt of the Federal government to reduce its deficit and the consequent transfer of expenditure to state and local governments.

Nearly 19 percent of Ohio's employment in Sector 353 in 1982 was in the production of industrial trucks and tractors, compared with 8.4 percent of the national industry. Employment in this sector peaked in 1979, declined by about 6 percentage points annually in 1980 and 1981 and then dropped 28 points in 1982 and 1983. As in the case of industrial machinery, the accelerated decline after 1981 is attributable to a sharp drop in exports and the cyclical decline in the domestic demand for industrial equipment.

SIC 354: Metalworking Machinery. This subsector is the largest employr in Ohio's machinery sector, employing 58,300 persons in the peak year 1980, about 25 percent of the sector total employment. Employers in 1,176 establishments produce tools and dies, tool accessories, power driven hand tools, rolling mill machinery and metalworking machinery.

Employment growth has been quite modest since 1972 with a sharp decline after 1981 to record lows. Year-to-year rates of change are shown in Table 35.6 below. Between the peak years 1974 and 1980, employment increased at an average annual rate of only .25 percent at the national level and declined at a rate of .9 percent at the state level. Between the 1972 and 1976 cyclical troughs, U.S. employment increased at an average rate of 1.81 percent and Oho employment at 1.38 percent. From the 1976 trough, national employment fell an average 1.29 percent to 1983 while Ohio

Table 35.6

Metalworking Machinery (SIC 354)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	50,600	—	—	—	92.8	88.1	17.69
1973	56,700	6,100	12.05	12.01	104.0	98.7	17.69
1974 (P)	60,400	3,700	6.52	5.39	110.8	102.8	17.88
1975	55,000	-5,400	-8.94	-9.13	100.9	94.5	17.92
1976 (T)	53,400	-1,600	-2.90	-0.04	98.0	94.5	17.41
1977	54,500	1,100	2.05	5.54	100.0	100.0	16.83
1978	55,400	900	1.65	7.10	101.7	106.8	15.97
1979 (P)	58,000	2,600	4.69	6.34	106.4	113.6	15.73
1980	58,300	300	0.51	0.75	107.0	114.9	15.69
1981	55,100	-3,200	-5.48	-2.93	101.1	111.7	15.28
1982	46,800	-8,300	-15.06	-11.17	85.9	96.7	14.61
1983 (T)	38,400	-8,400	-17.94	-12.14	70.5	86.0	13.64
1984*							
1972-83			-2.09	+ .16			
1972-79			+ 2.09	+4.13			
1979-83			-8.45	-6.01			

employment dropped at a 4.01 percent rate in the same period. As a component of the durable producers goods industry, this sector has been very sensitive to cyclical change in the general economy. The range of since 1972 are:

Range of Trough-to-Peak and Peak-to-Trough Changes

	Ohio	U.S.
Expansion 1972-74	+19.4	+18.1
Contraction 1974-76	-11.6	- 9.2
Expansion 1976-80	+ 9.2	+21.6
Contraction 1980-83	-34.1	-25.2

Until 1977, the Ohio sector's performance was almost identical to the national industry and the state share of sector employment remained between 17 and 18 percent. In the weak recovery after the 1976 trough, the Ohio sector lagged behind the national rate and the state's share fell to a range of 15 to 16 percent. With an employment loss of 33 percent in 1982 and 1983 (versus 23.3 at the national level) the state share dropped to 13.6 percent of the industry total.

Some part of this difference reflects change in the commodity structure of state and national sectors, although time series data at disaggregate levels are not available to indicate the extent of structural effects. Employment in the Ohio sector is more heavily concentrated in metalworking machinery (metal cutting and metal forming machine tools) than is characteristic of the industry: 40.7 to 27.8 percent. These subsectors tend to be more responsive to changes in aggregate demand than other subsectors. Nationally employment in SIC 3541 (metal cutting machine

tools) fell 34.1 percent from 1979-1983, compared to 24.2 percent for the sector as a whole.

Table 35.7

		Ohio		U.S.	
		Employment	%	Employment	%
3541	Metal Cutting Machine Tools	14,952	32.0	67,052	21.2
3542	Metal Forming Machine Tools	4,071	8.7	20,934	6.6
3544	Special Dies, Tools	16,482	35.2	124,785	39.4
3545	Machine Tool Accessories	6,145	13.2	59,163	18.7
3546	Power Hand Tools	2,088	4.5	24,704	7.8
3547	Rolling Mill Machinery	2,333	5.0	7,764	2.5
3549	Metalworking, nec	654	1.4	12,234	3.9

A major factor affecting employment growth and Ohio's share in this industry is the recent decrease in exports and the increase in imports stimulated by exchange rates. In 1972 exports were 15 percent of total shipments in metal cutting machine tools and nearly double the value of imports. By 1979 imports were 78 percent above exports and provided 19 percent of the new supply. By 1982 imports exceeded exports by 94 percent and had 24.4 percent of new supply. Both exports and imports dropped in 1981 and after but exports dropped more rapidly and by 1983 the import share of new supply was 31.5 percent.

A similar pattern is evident in metal forming machine tools with the exception that imports have continued to increase in both absolute and relative terms through 1982. The import share, which was under 6 percent in 1972, reached 27 percent in 1983. The sector has been export

oriented, accounting for a third of all shipments in 1983 and 21 percent in 1979 at the peak of domestic demand.

Exports have not been an important component of the market for special dies, tools and jigs (SIC 3544), a sector with 35.2 percent of Ohio's machinery sector employment. Increasing imports have reduced the domestic industry share of the market by about 5 percent since 1979 but the decline in the real rate of shipments of nearly 25 percent is a product of the state of investment demand in manufacturing.

The BLS long-term projection for sector 354 estimates 1990 employment at 85,400, an increase of 4.5 percent over 1979 and 3.3 percent over the peak year 1980, but a 22.7 percent gain over 1982. On the base projection, a shift-share projection over the period 1965-1983 would estimate Ohio's employment in 1990 at 41,000, while a simple regression would indicate a level of 44,400. Both values are distorted by the recession years 1982 and 1983 and by the structural factors mentioned earlier. The great probability is that Ohio employment will recover to near its long-term level of between 50,000 and 60,000, a range it held from 1970 to 1981. At a constant share of 14.6 percent--its 1982 share--1990 employment would be 56,200, about 3.2 percent below the 1979 level and 1.5 percent above the 1970 to 1981 average. This estimate is used in the current matrix projection model.

SIC 355: Special Industrial Machinery. Establishments in this sector manufacture machinery for the food processing, textile, woodworking, paper and printing industries and for a variety of other industrial processes. Ohio's employment in this sector is highly concentrated in three subsectors: SIC 3551 (food products machinery), 11.5 percent; and SIC 3559 (special industry machinery, nec), 49.7 percent. The latter subsector

includes about 50 subsectors of manufacturing; among them smelting and refining, foundries, chemicals, plastics, rubber products and glass making.

Because of the nature of the purchasing industries as producers of durable goods, employment in this sector is volatile in the short term in response to cyclical changes in economic activity. Although the Ohio sector is structurally different than the national industry, employment changes have been generally consistent with the nation. In the two cycles after 1971 changes were:

	Ohio	U.S.
Expansion 1972-74	+16.6	+15.7
Contraction 1974-76	- 9.0	-10.6
Expansion 1976-79	+ 9.8	+12.1
Contraction 1979-83	-34.7	-21.6

The magnitude of the employment loss after 1980 appears to be related to the greater weight of SIC 3559 in Ohio's commodity structure, in particular because of the weight in that sector of machinery for the metals, rubber and glass industries and the impact of the recession on these sectors. In the future they may be offset by high growth sectors such as plastics, chemicals, pharmaceuticals and construction materials. Given the diversity of that subsector, it is difficult to estimate the impact of imports or changes in export markets on demand for special industrial machinery. Exports of textile and leather machinery increased by 154 percent between 1970 and 1979 and fell by 20 percent by 1982. Imports increased by 130 percent between 1970 and 1979 and continued to rise by 11 percent through 1982. By that year, imports were about 67 percent greater than exports but their total value was less than 3 percent of machinery exports.

As indicated in Table 35.8, employment increased at an annual rate of 2.3 percent for Ohio and 2.28 percent for the industry between 1972 and 1979. It fell by an average of 8.68 percent and 5.4 percent respectively after 1979. The magnitude of the decline in 1981 to 1983 produced a negative average growth rate for the entire period.

The BLS long-term growth rate projects U.S. employment in the sector to be 210,000 in 1990, about 2 percent above the 1979 level and 17 percent over 1982. At this base rate for the national industry, shift-share projections for Ohio would estimate 1990 employment as 23,300, compared to an average of 23,700 for the period 1973-1980 and a period range of 20,400 (1965) to 24,500 (1979). That estimate is included in the current projection matrix. It is 4.9 below the 1979 peak but 45 percent above the 1982 trough. It assumes that interest rates will decline toward long-term norms and foreign exchange rates will move toward more realistic levels.

SIC 356: General Industrial Machinery. Nearly a third of Ohio's employment in this sector was engaged in the manufacture of bearings. Another 42 percent were producing pumps and pumping equipment, blowers, fans and compressors. The residual were in firms producing industrial patterns, speed changers, industrial furnaces, power transmission equipment and other general industrial machinery.

Apart from the importance of bearings in the product mix, the commodity composition of Ohio's output is not distinctly different than that of national industry.

Table 35.8

Special Industrial Machinery (SIC 355)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	21,100	—	—	--	89.0	93.2	11.92
1973	24,000	2,900	13.74	9.60	101.7	102.1	12.37
1974 (P)	24,500	500	2.08	5.65	103.8	107.8	11.96
1975	22,500	-2,000	-8.16	-10.00	95.3	97.1	12.20
1976 (T)	22,300	-200	-0.88	-0.72	94.5	96.4	12.18
1977	23,600	1,300	5.82	4.04	100.0	100.0	12.39
1978	23,600	0	0.00	3.93	100.0	103.4	11.92
1979 (P)	24,500	900	3.81	3.68	103.8	108.1	11.93
1980	24,200	-300	-1.22	1.51	102.5	109.1	11.61
1981	21,300	-2,900	-11.98	-2.64	90.3	104.5	10.50
1982	18,200	-3,100	-14.55	-11.53	77.1	92.8	10.14
1983 (T)	16,000	-2,200	-12.08	-10.64	67.8	84.7	9.98
1984*							
1972-83			-2.20	+ .82			
1972-79			+2.30	+2.28			
1979-83			-8.68	-5.40			

Table 35.9

		Ohio		U.S.	
		Employment	%	Employment	%
3561	Pumps & Pumping Equipment	7,320	21.3	55,977	19.4
3562	Bearings	10,643	31.0	48,825	16.9
3563	Compressors	3,402	9.9	28,753	10.0
3564	Blowers & Fans	3,636	10.6	37,023	12.8
3565	Industrial Patterns	1,269	3.7	8,900	3.1
3566	Speed Changers, etc.	2,447	7.1	22,641	7.8
3567	Industrial Furnaces	2,053	6.0	18,115	6.3
3568	Power Transmission Engines, nec	1,866	5.4	20,190	7.0
3569	General Industrial Machinery	1,736	5.1	48,010	16.6

The long-term rate of growth for the Ohio component has been below the national industry average, although both sectors had strong positive growth until 1979, and radical decline in 1982 and 1983. In the early period, growth in the Ohio sector averaged 2.97 percent annually, compared to 3.28 percent for the nation. After 1979 employment fell at an average rate of 7.68 percent in Ohio and 5.73 percent for the industry (see Table 35.10).

Employment in the sector has also been highly cyclical with growth exceeding loss in the initial cycle but with a radical loss in 1981 and 1982. The magnitude of the decline is obviously the product of the historically high interest rates. Although imports induced by exchange rates have contributed to the decline, they do not appear to be the primary factor.

Table 35.10

General Industrial Machinery (SIC 356)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Avg. Growth Rate Ohio	Avg. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	35,100	—	—	—	89.1	90.7	13.12
1973	38,100	3,000	8.54	9.05	96.7	98.9	13.06
1974 (P)	39,900	1,800	4.72	6.07	101.3	104.9	12.89
1975	37,400	-2,500	-6.26	-6.43	94.9	98.1	12.91
1976 (T)	37,600	200	0.53	-1.15	95.4	97.0	13.13
1977	39,400	1,800	4.78	2.97	100.0	100.0	13.36
1978	41,200	1,800	4.56	5.83	104.6	106.0	13.20
1979 (P)	42,400	1,200	2.91	5.48	107.6	111.5	12.88
1980	39,800	-2,600	-6.13	-1.85	101.0	109.7	12.32
1981	39,600	-200	-0.50	-2.91	100.5	109.4	12.63
1982	34,200	-5,400	-13.63	-9.66	86.8	97.4	12.07
1983 (T)	29,400	-4,800	-14.03	-10.27	74.6	85.9	11.57
1984*							
1972-83			-1.47	- .47			
1972-79			+2.97	+3.28			
1979-83			-7.68	-5.73			

	Ohio	U.S.
1972-74	+13.7	+15.7
1974-75/76	- 6.3	- 7.5
1975-79	+13.4	+14.9
1979-83	-30.7	-23.0
(1981-83)	(-25.8)	(-21.5)

Ohio's major component in sector employment (bearings) has had a more vigorous growth over the period and a smaller loss after 1979 than the sector as a whole. The value of output in constant dollars in 1981 was nearly 30 percent above the 1972 level although it dropped by 11 percent between 1981 and 1983.

Although imports gained relative to exports until 1981, they dropped more rapidly in the last two years. At their peak in 1981 they were 8.6 percent of the new supply. By 1983, their share was down to 6.9 percent. Exports in 1981 were 14.6 percent of shipments and held within .1 percent of that level through 1983. Employment in 1979 was 7.4 percent above 1972, but dropped 19 percent between 1979 and 1983. Another important component in the Ohio industry SIC 3561 (pumps and pumping equipment), is also a high growth sector. The constant dollar value of its shipments in 1979 was 35 percent above 1972 and in 1983 3.2 percent above 1979. Further, its export market has remained fairly strong while imports have not made significant relative gains. Exports were 17.9 percent of shipments in 1979, increasing in absolute amounts until 1982 and then dropping to 13.3 percent. Imports, which had increased from 3.2 percent to 6.1 percent of new supply between 1972 and 1979, fell to 4.8 percent by 1983.

Compressors (SIC 3563) have also been a strong growth industry. The real value of shipments increased by 80 percent between 1972 and 1979 and have remained at that level through 1983, with a compound growth rate of 5.5 percent annually through the period. Growth has been due in part to a strong export market and limited foreign competition. Exports in 1982 were 31.7 percent of shipments, falling to 24.3 percent in 1983 with some offsetting recovery in demestic demand. Imports which reached 8 percent of new supply in 1979 were down to 6.2 percent in 1983. Employment has not increased at the same rate as output and productivity increased at an average annual rate of 1.6 percent between 1972 and 1979.

Although the value of shipments of blowers and fans in 1979 was nearly 7 percent above the 1972 level, employment increased by 22 percent in the period. After 1979, shipment values dropped by 11.5 percent and employment by 24 percent. Imports have had a much greater effect on domestic shipments in this sector and foreign competition has limited export markets. Imports increased from 4.2 percent of new supply in 1972 to 20.5 percent in 1979 and 18 percent in 1983. Exports were only 8.8 percent of shipments in 1979 and 8.6 percent in 1983.

The Bureau of Labor Statistics base projection for Sector 356 for the United States is about 347,600 or 5.6 percent above the 1979 level and 21 percent abover the 1982 level. A shift-share model on the base for the period 1965-1983 would project Ohio employment at 42,300 and Ohio's share at 12.17 percent. This projection is probably conservative in view of the relative structure of the Ohio sector but it is incorporated in the aggregated projection-matrix.

SIC 357: Office, Computing and Accounting Machines. Ohio's machine industry employs only 7.6 percent of Sector 35 employment and nearly 55

percent of these workers are employed in SIC 3573 (calculators and accounting machines). Although 25.7 percent produce electronic computing equipment, the growth area of this sector, they comprise only 2.8 percent of the national industry total. Further, the largest proportion of employment in computing equipment is in the production of programmable accounting machines.

Table 35.11

		Ohio		U.S.	
		Employment	%	Employment	%
3572	Typewriters	—	—	14,337	3.0
3573	Electronic Computing Equipment	3,433	25.7	405,352	85.3
3574	Calc. & Acct. Machines	7.311	54.8	20,723	4.4
3576	Scales & Balances	1,206	9.0	7,464	1.5
3579	Office Machines, nec	1,395	10.5	27,429	5.8

National industry employment in sector 357 has increased at an average annual rate of 7.74 between 1972 and 1983, and at an accelerated rate in 1980 and 1981. Although employment growth remained positive in 1982 and 1983, the rate had fallen to 2.91 and 1.6 percent respectively.

In sharp contrast, sector employment in Ohio fell at an average rate of 4.4 percent from 1972 to 1979 and at 2.9 percent thereafter. Its share of national industry employment has fallen from 7.7 percent at the beginning of the period to 2.5 percent in 1983. This relative loss after 1974 is a result of the structural difference noted above with the very high growth in employment in computing equipment.

Actually, employment in the Ohio sector has been relatively stable since 1976, varying within a range of 12,000 (1976) to 14,900 (1980) and

Table 35.12

Office, Computing and Accounting Machines (SIC 357)
Employment: Ohio and the United States, 1972-1983

Year	Employment	Absolute Change	Ave. Growth Rate Ohio	Ave. Growth Rate U.S.	Emp. Index (1977) Ohio	Emp. Index (1977) U.S.	Ohio Share
1972	20,100	—	—	—	150.0	83.4	7.74
1973	17,200	-2,900	-14.42	9.45	128.4	91.2	6.05
1974 (P)	16,500	-700	-4.06	7.29	123.1	97.9	5.41
1975	13,900	-2,600	-15.75	-6.15	103.7	91.9	4.85
1976 (T)	12,000	-1,900	-13.66	0.13	89.6	92.0	4.18
1977	13,400	1,400	11.66	9.25	100.0	100.0	4.28
1978	13,500	100	0.74	10.41	100.7	112.3	3.90
1979 (P)	13,900	400	2.96	14.84	103.7	127.4	3.50
1980	14,900	1,000	7.19	8.54	111.2	138.8	3.45
1981	14,000	-900	-6.04	5.38	104.4	147.6	3.08
1982	13,400	-600	-4.28	2.91	100.0	151.9	2.73
1983 (T)	12,300	-1,100	-8.20	1.57	91.8	154.3	2.51
1984*							
1972-83			-4.13	+7.74			
1972-79			-4.40	7.55			
1979-83			-7.88	+5.29			

around an average of 13,400. The long term growth path for the national industry employment is projected to be a compound rate of +4.15 percent with employment being 619,000 in 1990. If the Ohio sector can maintain its low 1983 share, employment in 1990 should be about 15,600, an increase of 4.7 percent over 1980. This estimate is incorporated in the projection-matrix as a "best" estimate.

Table 35.13
Summary Projections:
Ohio Employment - 1990 Projected

SIC	1990	1990/1979	1990/1982
351	5,200	1.21	1.52
352	4,300	.81	1.34
353	28,900	.98	1.72
354	56,200	.97	1.46
355	23,300	.95	1.46
356	42,300	1.00	1.44
357	15,600	1.12	1.27
358	21,700	.95	1.39
359	22,600	.99	1.25
TOTAL	220,100	.98	1.48

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SECTOR 36

Electrical and Electronic Machinery, Equipment and Supplies

Ohio Employment: 1965-1990

WORKING DRAFT
November 1984

[For discussion only]

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Sector 36

Sector 36, electrical and electronic machinery, equipment and supplies, includes establishments manufacturing machinery apparatus and supplies for the generation, storage, transmission and utilization of electrical energy. Major subsectors include electric transmission and distribution equipment (SIC 361), electrical industrial apparatus (SIC 362), household appliances (SIC 364), radio and television receiving equipment (SIC 365), communications equipment (SIC 366), electronic components and accessories (SIC 367), and miscellaneous electrical machinery and equipment (SIC 369).

The relative weights of these subsectors in terms of employment can be seen in Figure 36.1 for the United States and Figure 36.2 for Ohio for 1975 and 1982--two recession years. At the national level there has been a significant structural shift in this nine year period. SIC 367 (electronic components) contained 19.9 percent of sector employment in 1973 and 28.3 percent in 1982. By 1982, this subsector and the communications equipment subsector contained 55.9 percent of the total.

In the same period, employment in the sector as a whole increased by 310,000. The communications equipment subsector gained about 98,000 jobs and the electronics subsector 230,000. SIC 369 (miscellaneous) added 15,000 and all other subsectors lost employees--a net loss of 33,000. This concentration of growth and the strength of growth in the two dominant subsectors has other structural implications in addition to the long term structural shift. All other subsectors have experienced a short term structural shift in the course of the business cycle. For example, SIC 364 (electric lighting) had 11.3 percent of sector employment in 1973, a peak

Figure 36.1

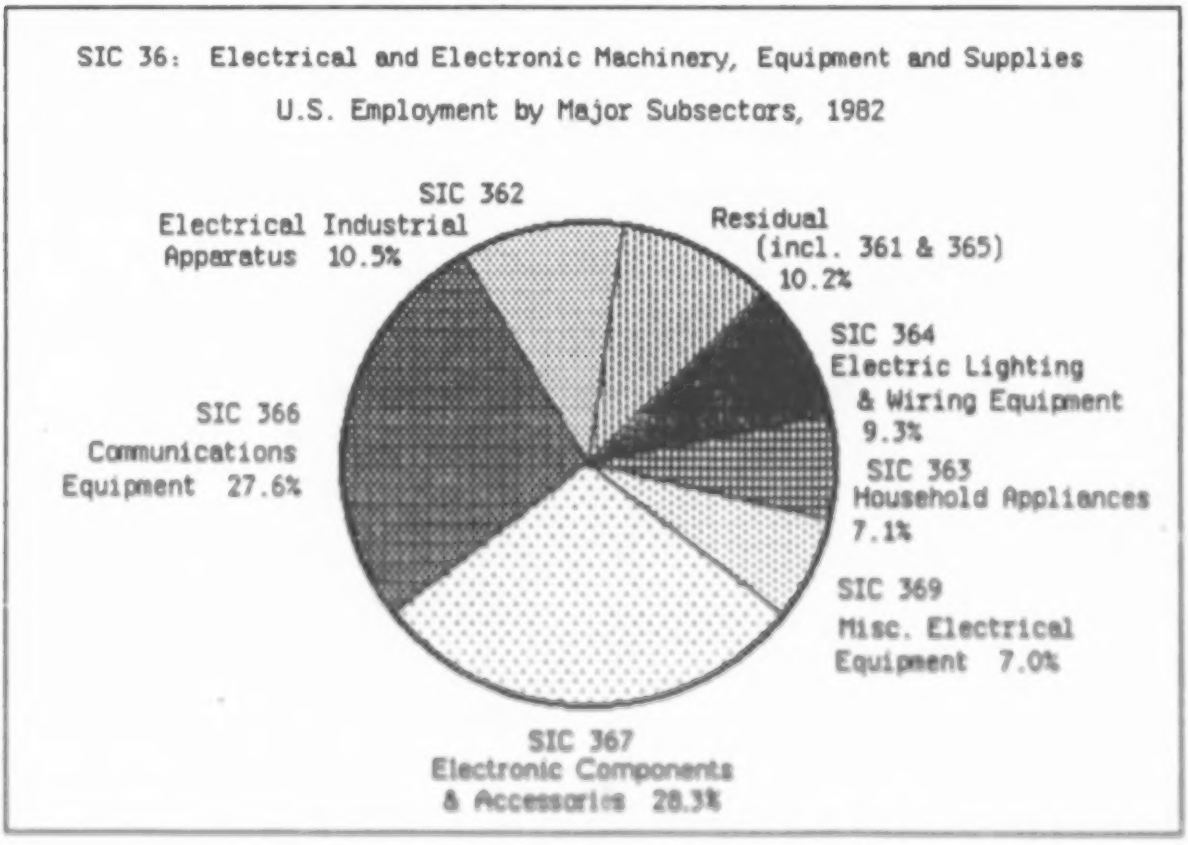
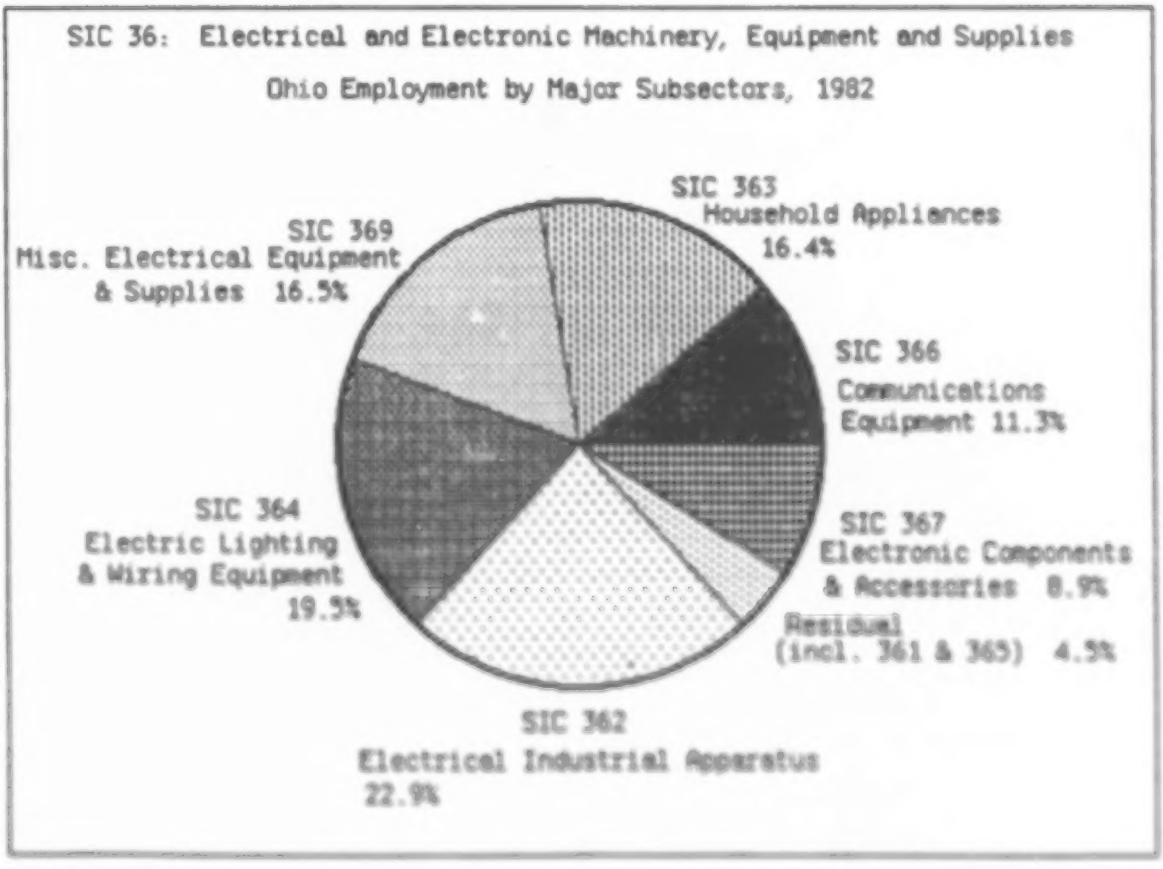

SIC 36: Electrical and Electronic Machinery, Equipment and Supplies
U.S. Employment by Major Subsectors, 1982
SIC 362
Electrical Industrial
Apparatus 10.5%
Residual
(incl. 361 & 365)
10.2%
SIC 364
Electric Lighting
& Wiring Equipment
9.3%
SIC 363
Household Appliances
7.1%
SIC 369
Misc. Electrical
Equipment 7.0%
SIC 367
Electronic Components
& Accessories 28.3%
SIC 366
Communications
Equipment 27.6%

Figure 36.2


SIC 36: Electrical and Electronic Machinery, Equipment and Supplies
Ohio Employment by Major Subsectors, 1982
SIC 363
Household Appliances
16.4%
SIC 366
Communications
Equipment 11.3%
SIC 367
Electronic Components
& Accessories 8.9%
Residual
(incl. 361 & 365) 4.5%
SIC 362
Electrical Industrial Apparatus
22.9%
SIC 364
Electric Lighting
& Wiring Equipment
19.3%
SIC 369
Misc. Electrical Equipment
& Supplies 16.5%

year. Its share dropped to 10.6 in the 1975 recession, increased to 10.9 in the peak year 1978 and dropped to 9.3 percent in 1982. This short term or cyclical shift in shares is a result of catching up with or falling further behind the dominant (persistent growth) sectors, with fluctuations in the general level of economic activity. As these sectors are not distributed in the same proportion geographically, these short term shifts affect employment projections based on shift-share techniques.

The effect of both long term and short term structural shifts on Ohio employment is evident in Figure 36.2. The two subsectors that dominate the national sector in size and growth contained only 20.2 percent of Ohio's employment in Sector 36 and the communications sector has lost employment in the face of strong national growth. Although the electronics sector has had a limited employment gain in the current recession, it still employs less than 9 percent of the sector total.

Ohio's "strength" in this sector is in electrical industrial apparatus, household appliances and electric lighting. These three subsectors employed 64 percent of all workers in the industry in 1973 and 53 percent in 1982. All of the relative loss in the period was in household appliances—a subsector particularly sensitive to the business cycle and to fluctuations in export demand. At the national level, employment in this sector declined from peak to peak and trough to trough between 1973 and 1982, with a net loss between the two recession years of nearly 20,000 jobs. In the same period, Ohio lost 8,000 jobs in this subsector.

Tables 36.1 and 36.2 show the relative performance of Ohio and the U.S. in this industry between the 1975 and 1982 recession years and the

Table 36.1

Sector 36: Electrical and Electronic Machinery, Equipment and Supplies
Employment: Ohio and the U.S., 1965-1982

Year	Employment (000's) U.S	Ohio	Ohio Share (Percent)	Percent Change U.S.	Ohio
1965	1629.2	125.2	7.7	—	—
1968	1940.9	141.9	7.3	+19.1	+13.3
1970	1882.2	144.3	7.7	-3.0	+5.5
1973	1969.5	134.1	6.8	4.6	-7.1
1975	1701.6	112.4	6.6	-13.6	-16.2
1979	2124.2	121.6	5.5	24.8	+8.2
1982	2011.1	93.4	4.4	-5.3	-23.2

Source: Bureau of Labor Statistics.

Table 36.2

Employment Index: U.S. and Ohio
Peak to Peak and Trough to Trough

SIC	Trough 1982/1975 U.S	Trough 1982/1975 Ohio	Peak 1978/1973 U.S.	Peak 1978/1973 Ohio
361	96.9	102.9	89.5	76.8
362	100.0	85.6	103.4	99.3
363	88.0	66.2	93.0	82.1
364	103.0	87.1	97.8	87.3
365*	84.8	42.9	76.9	60.0
366	121.5	69.9	105.4	79.1
367	168.2	103.8	110.8	100.0
369	111.3	101.3	114.5	113.0

*Ohio employment negligible.

Source: Bureau of Labor Statistics.

1973 and 1978 peak years. At the national level, four of the eight subsectors had peak to peak employment gains. In Ohio only one subsector did so. In the 16 observations in this analysis, in only one was Ohio's gain greater or the loss less than for the U.S.

As a generalization, employment in Ohio's subsectors, with the exception of SIC 366, tends to move with the national level but with weaker gains and larger losses, indicating that the industry is subject to both long term and short term changes in demand and long term and short term structural shifts. An attempt to estimate the relative importance of demand versus structural changes betwen 1978 and 1983 is shown in Table 36.3 below.

The employment effects of demand and structural forces are estimated as the difference between actual employment in 1983 and the sector growth path. The structural effects are estimated by applying Ohio's actual share of national employment in 1978 and 1983 to the 1983 industry employment. The differences between these two estimates of 1983 employment is the structural loss or gain. The residual difference is the result of demand forces.

In sectors 361, 362 and 364, employment levels in 1983 that were below the 1978 level and the industry growth path were a result of demand deficiencies, most of which appear to be short term, cyclical in nature. In sectors 363, 366, 367 and 369, the dominant force appears to be structural--a decline in Ohio's share of national output. These factors are discussed below in greater detail. One way note here, however, that in sectors 366 and 367 (electronic and communications equipment), Ohio's employment is relatively stable while the industry experiences very high

Table 36.3

SIC 36: Employment Loss or Gain
by Subsector and Source, 1979-1983

SIC	Total Change[1]	Demand Effect	Structural Effect
361	-1,200	-800	-400
362	-9,400	-6,600	-2,800
363	-10,700	-3,600	-7,100
364	-5,300	-4,300	-1,000
366	-3,700	+400	-4,100
367	-3,000	+100	-3,100
369	-2,200	+600	-2,800
36	35,700	14,400	21,300
	100%	40.4%	59.6%

[1]Difference between actual employment 1983 and the sector growth path 1979-1995 (BLS Base Projection - 1995).

growth in other geographic areas. In sector 363 (household appliances), the structural forces include the fact that the Ohio share of this industry is highly specialized and interdependent with construction. It is also an important export sector and consequently domestic growth is not reflected in Ohio.

Employment Projections

The employment projections for 1990, below, are based in part on the industry growth rates associated with the BLS 1995 projections for the national economy and the detailed analysis for each major three-digit sector which follows. The BLS growth rates that are utilized are trend rates from actual 1979 employment to their 1995 projections. These rates are used in lieu of their published 1982-1995 rates because the unemployment rate in 1979 was similar to the rate assumed in the 1995 projections. Consequently, the 1990 projections in Table 36.4 below are growth projections with an implicit 6 percent unemployment rate rather than predictions of the level of economic activity for a given year.

Table 36.4

Sector 36: Employment, 1978 and 1983 Actual and 1990, Projected

SIC		Employment Ohio 1978	1983	1990 high	1990 med	1990 low	Growth Rates (%) U.S. (Base) 1990/78	Ohio (Base) 1990/78
361	Electric Transmission	4,300	3,400	4,300	4,600	4,900	19.0	7.0
362	Industrial Appar.	27,000	18,700	23,100	24,300	26,200	11.5	-10.0
363	Household Appl.	27,100	15,900	20,100	20,600	22,400	0.9	-24.0
364	Lighting & Wiring	22,700	18,100	23,000	23,900	24,200	12.0	5.3
365	Radio & TV Equip.	900	700	800	900	1,000	-4.0	0
366	Communication Equipment	13,600	10,200	11,200	10,700	10,900	25.8	-21.3
367	Electronic Components	9,500	8,100	9,100	9,000	9,200	60.6	-7.3
369	Miscellaneous	16,600	15,100	18,500	18,600	18,900	13.5	12.0
TOTAL 36		121,700	90,200	110,100	112,600	117,700	25.0	-7.5

SIC 362: Electrical Industrial Apparatus

This set of industries produces such things as electric motors and power generators, industrial controls such as motor starters and controllers, electric welding apparatus, carbon and graphite products such as electrodes used in thermal and electrolytic processes, batteries, capacitors and chargers.

In Ohio the major areas of production focus on motors and generators and welding apparatus. In 1983, Electrical Industrial Apparatus employed some 18,700 workers, accounting for the largest percentage of any individual subsector of Electrical and Electronic Equipment (20.73 percent). (See Figure 362.1.) Historically, since 1965, SIC 362 has accounted for the largest numbers, up to 25.34 percent, of SIC 36 in Ohio. Absolute employment levels have tended to fluctuate in response to the general business cycle patterns with an overall downward trend (Figure 362.2.)

In contrast, national trends in Electrical Industrial Apparatus, while also showing cyclical fluctuations, show a relatively constant employment level over the past 14 years (Figure 362.3.)

This comparison between Ohio and national trends is further illustrated in Figure 362.4, which shows the overall decline of Ohio's relative share of national employment for this subsector, from over 16 percent in the 1960's to less than 10 percent in 1983. At the same time, however, the concentration of workers in this industry in Ohio has remained high--more than twice the national concentration. (See Table 362.1.) The high location quotient indicates that changes in this industry have a

Figure 362.1

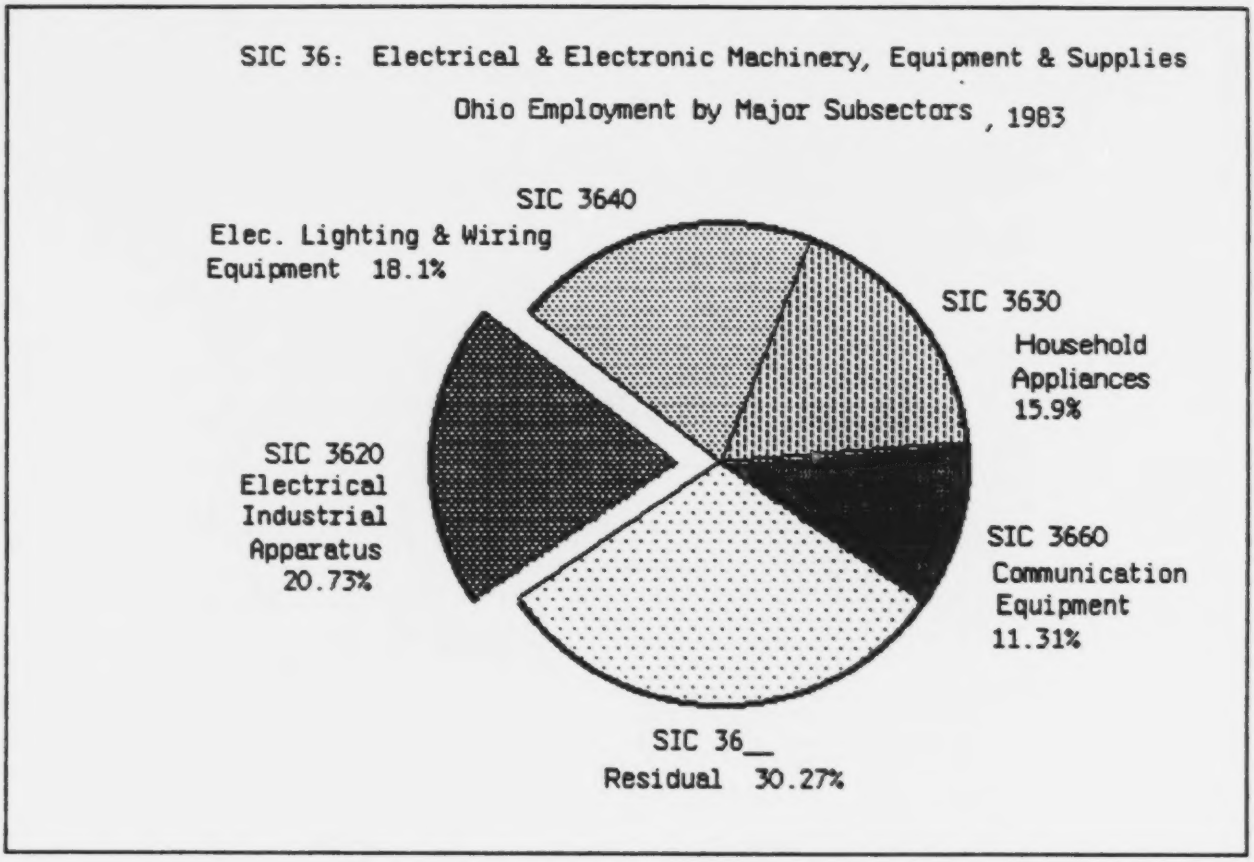

SIC 36: Electrical & Electronic Machinery, Equipment & Supplies
Ohio Employment by Major Subsectors, 1983
SIC 3640
Elec. Lighting & Wiring
Equipment 18.1%
SIC 3630
Household
Appliances
15.9%
SIC 3620
Electrical
Industrial
Apparatus
20.73%
SIC 3660
Communication
Equipment
11.31%
SIC 36__
Residual 30.27%

Figure 362.2
SIC 362: Ohio Employment Trends

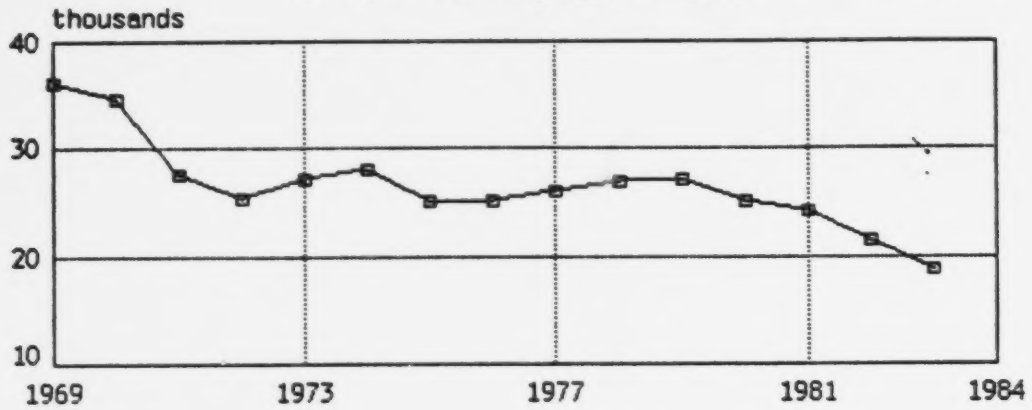


Figure 362.3
SIC 362: U.S. Employment Trends

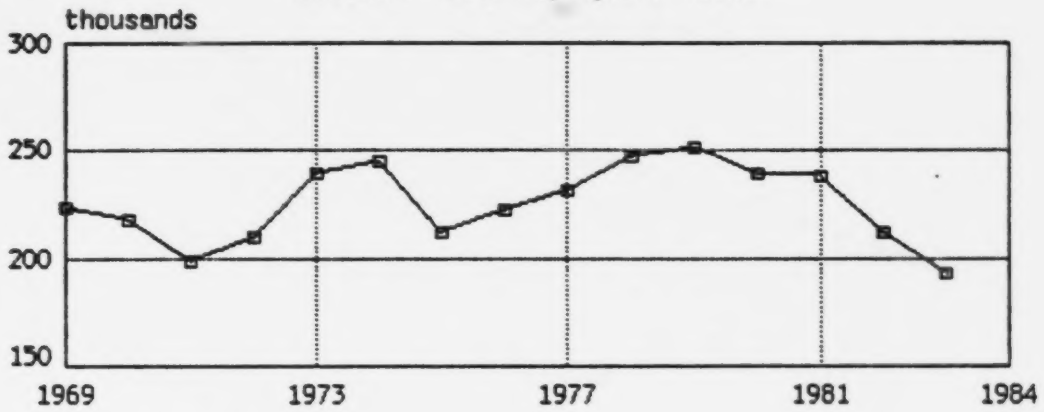


Figure. 362.4

SIC 362: Ohio's Percentage of National Employment

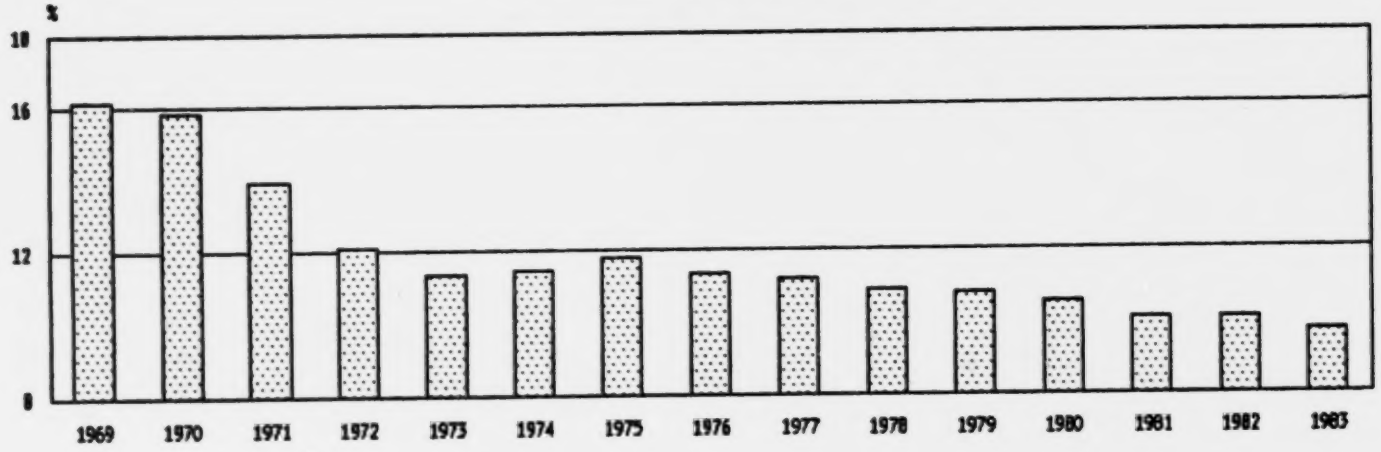


Table 362.1

Location Quotient for SIC: 362

Variations from 1969-1983

1969	2.92
1970	2.90
1971	2.58
1972	2.27
1973	2.12
1974	2.15
1975	2.26
1976	2.20
1977	2.18
1978	2.13
1979	2.16
1980	2.16
1981	2.14
1982	2.24
1983	2.17

greater effect on Ohio, employment-wise, than they do upon the nation as a whole.

Demand

The demand for the products produced by industries included in the Electrical Industrial Apparatus subsector is based upon the demand from other industries which use the parts produced by this subsector, as well as even broader forces. For example, the housing market determines in great part the demand for major appliances, which in turn affects the demand for motors. Also, the levels of investment in new plant and equipment determine the demand for industrial controls. In addition, demand for refrigeration and heating equipment, construction machinery, heavy construction machinery and farm equipment as well as automobiles all influence demand for Electrical Industrial Apparatus.

Domestic demand for motors and generators and industrial controls is "cautiously optimistic," according to the U.S. Industrial Outlook, while the growth in welding apparatus is expected to increase at a 6 percent rate through 1990.

Trade

While information on trade in this subsector is sparse, figures available for two of its industries, namely welding apparatus and carbon and graphite products indicate that, while imports have grown at a rate slightly beflow the rate for total shipments, exports have been growing at a faster pace. (Source: Predicasts and U.S. Industrial Outlook.)

Technology

Major technological advancements which affect production in this subsector are the introduction of numerically controlled machine equipment and advanced production equipment. While both of these technological improvements lower the "unit labor requirements" in the production process, this does not necessarily imply immediate worker displacement. In fact, numerically controlled machine equipment requires changes in the skills for the machine operator and the addition of two new positions: programmer and maintenance workers with electronic knowledge.

In addition to technological effects on production, technology also affects the demand for products in this subsector. The new automated welding equipment and "intelligent vision" arc welding robots used by other industries to reduce costs and improve efficiency and quality are in high demand.

Subsector Outlook

As mentioned earlier in this report, Ohio's share of national employment in Electrical Industrial Apparatus has been decreasing over the past 14 years. However, the projected increases in the demand for motors and generators and the optimistic outlook for welding apparatus could in the near future reverse this trend. While employment levels are not expected to increase significantly due to the introduction of labor saving equipment in the production processes, neither are they expected to decline dramatically over the longer term.

SIC 363: Household Appliances

This subsector includes household cooking equipment, refrigerators and freezers, laundry equipment, electric housewares and fans, vacuum cleaners, sewing machines and miscellaneous (NEC) household appliances.

Ohio's industry produces and exports household laundry equipment, vacuum cleaners, electric housewares and electric cooking equipment. As a group, household appliance manufacturers account for nearly 16 percent or the third largest number of jobs in the Ohio electrical and electronic equipment sector (Figure 363.1). Historically at a national level, employment levels in these industries have remained relatively stable, with some cyclical variations. Over the past 14 years national employment levels have shown a minimal decline of .53 percent annually (gross average annual decline), representing some 40,000 jobs from 1969 to 1983. During the same interval, however, Ohio's employment has shrunk by more than 50 percent--a drop of some 19,000 jobs. In other words, Ohio's job loss has accounted for nearly half the national decline in household appliances. (See Figures 363.2, 363.3 and Table 363.1).

This difference between state and national trends is depicted still further in Figure 363.4, which shows Ohio's percentage share of national employment. The graph shows the decline from nearly 20 percent (18.72) in 1969 to just over 10 percent in 1983. The graph also shows that Ohio industry has been more sensitive to highs and lows in the business cycle than employment nationally (i.e., Ohio percentages are lower during recessions and higher during boom periods). The higher sensitivity to general business cycles can be explained in part by the higher concentration of household appliance workers in Ohio compared with the

Figure 363.1

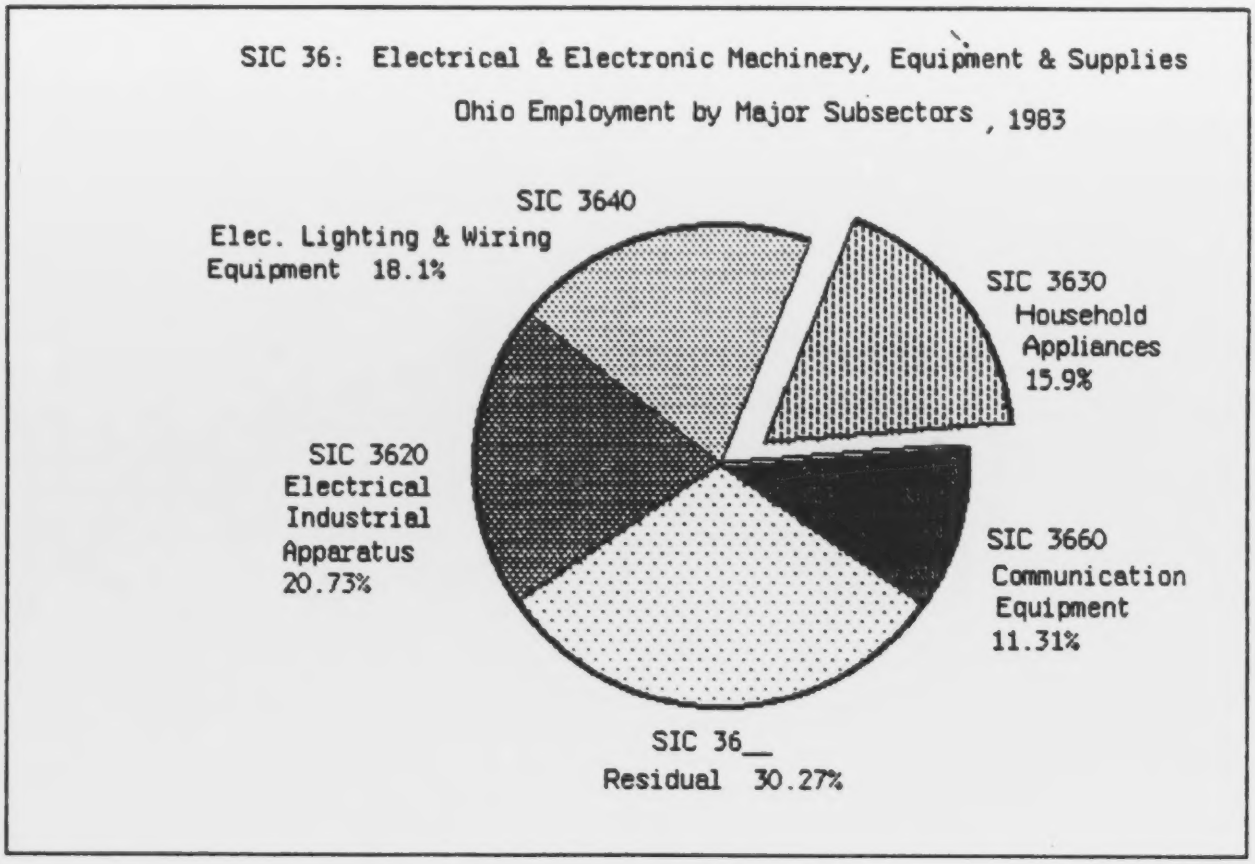

SIC 36: Electrical & Electronic Machinery, Equipment & Supplies
Ohio Employment by Major Subsectors, 1983
SIC 3640
Elec. Lighting & Wiring
Equipment 18.1%
SIC 3630
Household
Appliances
15.9%
SIC 3620
Electrical
Industrial
Apparatus
20.73%
SIC 3660
Communication
Equipment
11.31%
SIC 36__
Residual 30.27%

Figure 363.2

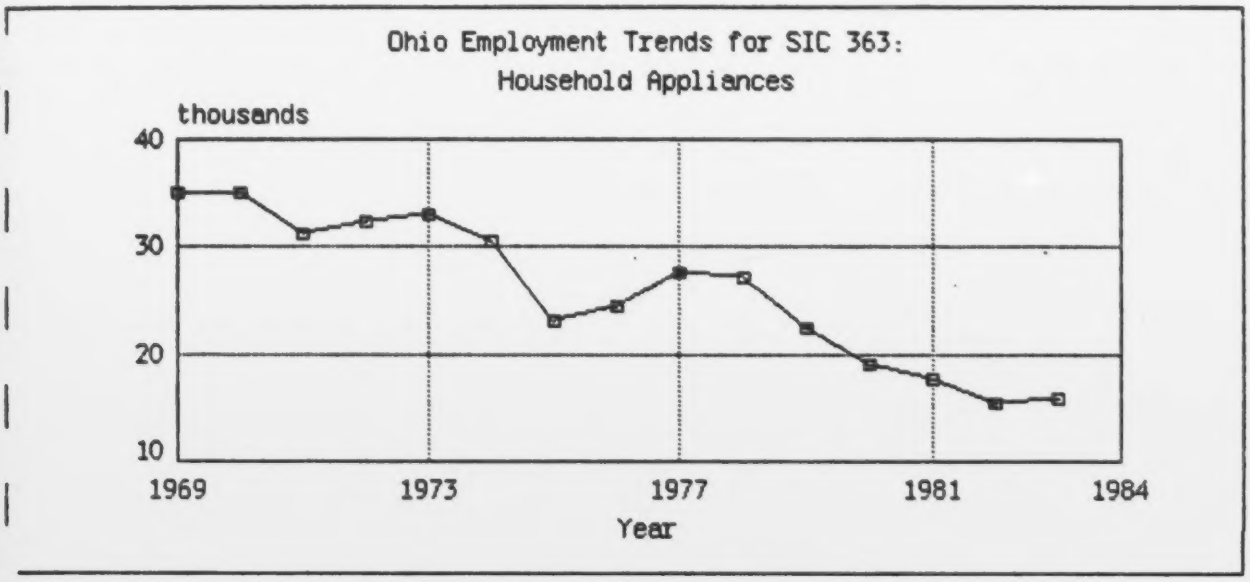

Ohio Employment Trends for SIC 363:
Household Appliances
thousands
40
30
20
10
1969
1973
1977
1981
1984
Year

Figure 363.3

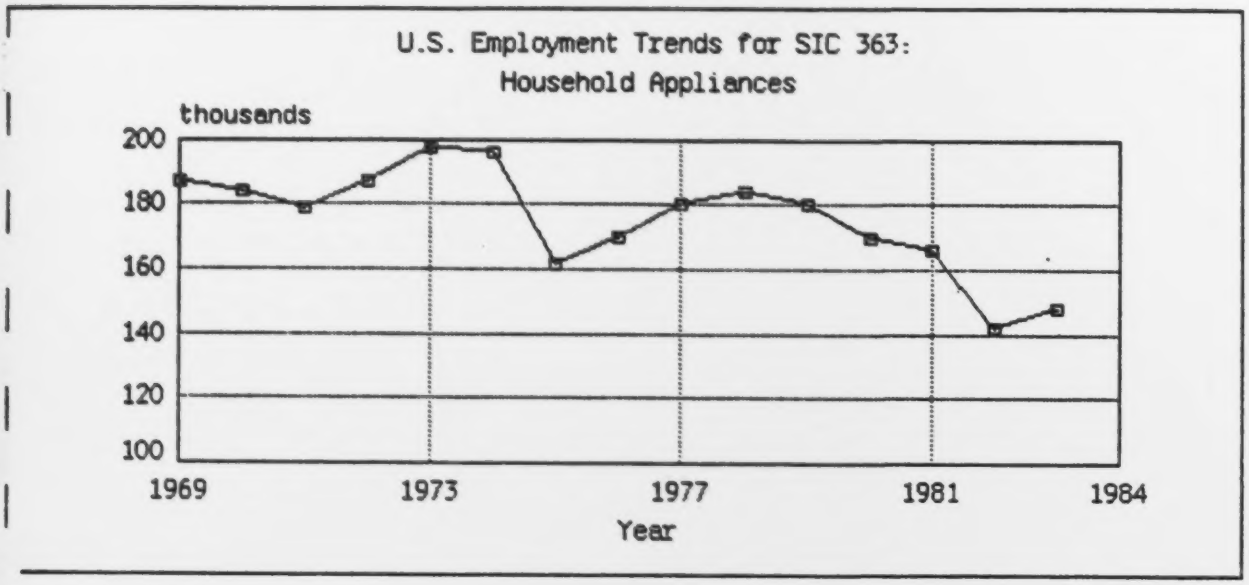
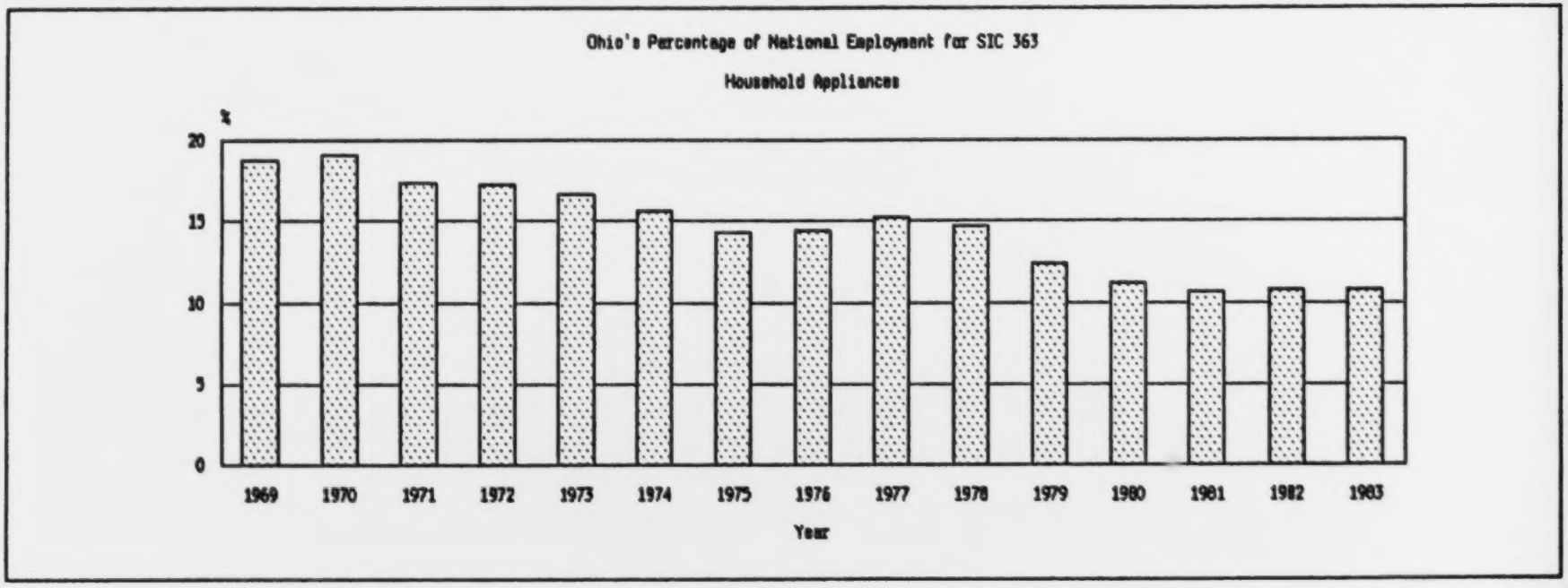

U.S. Employment Trends for SIC 363:
Household Appliances
thousands
200
180
160
140
120
100
1969
1973
1977
1981
1984
Year

Table 363.1

Household Appliances
U.S. Distribution of Employment

	1982 Employment (in 1000's)	%	15 Year Trend	1978 Employment (in 1000's)	%	1979 Employment (in 1000's)	%
SIC 36	141.3	100.0		184.9	100.0	178.3	100.0
3631	27.3	19.3	2.56	21.6	11.7	21.6	12.1
3632	26.1	18.5	4.96	45.4	24.6	38.7	21.7
3633	19.4	13.7	1.66	23.1	12.5	22.6	12.7
3634	43.9	31.1	0.66	53.5	28.9	54.2	30.4
3635	9.5	6.7	0.86	10.5	5.8	11.2	6.3
3636	6.0	4.2	-1.26	8.4	4.5	8.0	4.5
3639 (nec)	15.4	10.9	1.46	16.4	8.7	17.3	9.7

Figure 363.4


Ohio's Percentage of National Employment for SIC 363
Household Appliances
%
20
15
10
5
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
Year

national figures. The location quotient (Table 363.2) shows that production (actually employment) concentration has historically been 2.25 to 3.5 times that of the nation for this subsector.

Domestic Demand

A major, although partial, factor in the final demand for labor is domestic demand for the industry's products. This can be measured by consumer expenditures (preferably in constant dollars) or total product shipments (value in constant dollars, or absolute number of units shipped) less exports plus imports. Historically, consumer expenditures on household appliances have experienced an annual growth rate of 4.8 percent[1] since 1967. The expenditure figures also show cyclical variations: consumers spent some $600 million (approximately 6 percent) and $700 million less on household appliances in the recessions of 1975 and 1982 respectively than they had in the previous year. On the other hand, in the periods from 1977-79 and 1982-1983 when the economy was on an upswing, appliance industry consumer expenditures increased by 5.4 percent and 17.2 percent respectively.

The factors which affect domestic demand for household appliances can be separated into two types: cyclical and structural. Cyclical variables, such as interest rates, level of personal disposable income, consumer confidence and expectations about the future economy, and new housing starts all affect "short-term" levels of demand. Another cyclical variable which plays an important role in domestic demand is the set of international import price indices or, simply, the relative strength of the U.S. dollar on the international market. In the 1982-1983 "boom," all of these cyclical factors favored increased demand, and they can be held

Table 363.2

Location Quotient for SIC: 363

Variations from 1969-1983

1969	3.39
1970	3.48
1971	3.22
1972	3.22
1973	3.11
1974	2.93
1975	2.74
1976	2.79
1977	2.96
1978	2.88
1979	2.47
1980	2.28
1981	2.26
1982	2.39

accountable for the greater proportion of the increase in household appliance shipments. Economic analysts suggest these forces will continue to play a positive role during 1984, and they estimate further increases in demand of approximately 8 to 9 percent this year. In order to attempt to assess the longer term trends in household appliance demand, however, it is necessary to examine the underlying structural variables.

Saturation of markets: Probably the most important factor exerting a downward pressure on the overall level of domestic demand of major appliances over the past two decades has been the high degree of market saturation. For example, currently over 99 percent of American homes have a refrigerator and a gas or elecltric range, while some 77 percent have a washing machine. The reason for the "net downward pressure" on demand is the long average life expectancy for major appliances, which ranges from ten to fifty years. Not all appliances have saturated markets, however, and the relatively low saturation can be a highly motive force on demand. One notable example is in the case of microwave ovens, whose current saturation point of 35 percent is expected to increase to 50 percent by 1986. Other appliances showing high (30 percent) rates of growth in 1983 and whose markets are unsaturated are dishwashers and waste disposers. The rate of market penetration of new products combined with the degree of saturation (current and ultimately expected) for all appliances will determine the structure of final demand for the industry's products.

Replacement demand: The positive aspect of the high degree of market saturation is that it generates an almost automatic replacement demand every 10 to 15 years or so. As a result of this replacement cycle, industry observers are currently anticipating increases in demand over the

next 2 to 4 years resulting from replacements of major appliances sold in the 1973 boom year.

Age distribution of the population: Because it affects the rate of formation of new households, this factor is likely to impact on the overall level of household appliance demand. That is, as the baby boom generation movers through the life cycle, it generates waves of demand in various industries. As the formation of new independent households by this group reaches completion somewhere between 1985 and 1988, overall demand for household appliances--in particular, major appliances--will diminish accordingly.

Changing lifestyles: This results in the increased demand for time-, energy- and space-efficent appliances which also offer greater variety and versality in the performance and control of functions/operations. For example, change in the percentage of women in the labor force has had a negative effect on the demand for sewing machines while the demand for time-saving appliances has been growing. During the past decade, the overall domestic demand for sewing machines declined 60 percent while the annual rate of increase for microwave ovens has been 39 percent.

Since the initial energy crunch in 1973 consumers have become energy conscious, demanding more quality in the form of energy-efficient products. This trend has been greatly aided by the Federal Trade Commission's regulation requiring efficiency labels on seven categories of appliances. The expansion of apartments and condominiums in recent years has increased the number of smaller living spaces, in particular smaller kitchens. This in turn has created a demand for more compact major appliances, i.e., decreasing size while maintaining (or increasing) versatility and

functional features. The net effect of these "lifestyle changes" has been higher product quality expectations by domestic consumers and a subsequent increase in demand. That is, even though the demand for total number (units) of appliances may have remained constant, the effect of lifestyle changes has been to increase domestic demand due to increased quality per unit.

Rate of development and diffusion of new technology: Because of the general preference of consumers (other factors being equal) for more sophisticated, versatile appliances which offer greater control and number of options, the introduction of technologically innovative products on the market is frequently a stimulus to domestic demand. The introduction of new technologically improved electric ranges is one example. Shipments in 1983 jumped by 36.5 percent over 1972. Features added to electric ranges or refrigerators by solid state control technology to increase their versatility may generate demand by speeding up replacement of technologically obsolete appliances.

Although often dependent upon cyclical factors for their introduction, the ultimate effect of technological innovation on demand is structural. For example, solid state controls, switches and printed circuits (also produced in SIC 36) are slowly replacing mechanical controls and electrical wires in household appliances. Although the large scale introduction of microprocessors into the appliance industry has been constrained by prices, analysts project that by the mid-1980's 50 percent of all major appliances will be controlled by microelectronic devices.[2]

Forecast of Demand

Based upon anticipated continued increases in new households (10 percent over the next five years), as well as a continued rise in disposable income and a decrease in unemployment, industry analyst John Harris projects household appliance shipments to continue to grow at a compound annual rate of four percent through 1988.[3] R.F. Kutscher concurs and adds a prognosis for the following period:

> Most of the rebound in construction-related industries is expected to occur by 1988 or 1989. After that, growth is projected to taper off due to a projected slowdown in the rate of new household formation which would result in a diminishing rate of growth in the demand for new homes.[4]

Both analysts base their projections primarily on the rate of new household construction and formation, which is expected to "taper off" after 1988 due primarily to the underlying age distribution of the population.

It is highly likely, on the other hand, that the continued rise in labor force participation rates for women will exert a greater influence on overall domestic demand for household appliance demand in the next 5 to 10 year period. Higher levels of disposable income and a high priority for time-saving, quality products (whose current market saturation is low) will probably change the structure of goods produced, but the result will be a continued strong domestic demand in the longer term.

Trade

The role of trade in the household appliance industry has not generally been very great, but has been increasing over the past decade. Gross trade represented 9.7 percent of U.S. final goods production in 1972 and rose to 15 percent in 1983. (Comparatively, this figure was 28.1

percent for all commodities in 1983).[5] What is perhaps of even greater interest in assessing overall effects on employment is the balance of trade in this subsector, as well as the dispersion of the trade balance among the individual industries. In 1972 household appliances registered a $163.4 million deficit. This rose to a surplus of $162.4 million in 1981 and then fell drastically to a $600 million deficit in 1983.

Table 363.3

Calculation of Consumer Expenditures Based on Value of Total Shipments: Imports and Exports Deflated to 1972 Dollars

SIC 363	1977	1979	1982	1983
Shipments	10,736.6	12,740.9	12,746.0	15,026.0
+ Imports	829.3	957.5	1,180.1	1,540.0
- Exports	778.7	1,060.5	1,115.5	940.0
1972 Multiplier	.746	.672	.546	.524
1972 $	8,051.6	8.487.4	6994.9	8.194.7
		(435.6)		(1199.8)

D(1979-1977) is 5.4%

D(1983-1982) is 17.2%

Please note: These figures were calculated from figures posted in the U.S. Industrial Outlook. The calculated 1972$ expenditures by consumers are not considerably less than expenditure figures given in Predicasts.

Imports: The role of imports has steadily been growing over the past decade, from 6.2 percent[6] in 1972 to nearly 10 percent in 1983. Small appliances, especially electric fans, razors and hair dryers have been the primary targets of penetration by foreign producers in American markets. Larger appliances such as refrigeraters, washers and dryers and electric

ranges have been less susceptible to competition from imports due to their size and high costs of transportation. Foreign producers generally make smaller products which do not appeal to American consumers.

The rapid increases in domestic demand for appliances in 1982-83 due to the economic recovery left domestic producers unable to fill the demand. In addition, the relative strength of the dollar on the international exchange gave Americans greater purchasing power in foreign markets. Imports of household appliances grew more than 30 percent in this one year period. (This is more than twice the compound annual growth rate from 1972-83, 12.1 percent). The most vivid example is in the sales of microwave ovens. Domestic demand for this product jumped 40 percent from 1982-1983. One half of this increase was supplied by foreign manufacturers.

Even though this influx of imports may be considered a short-term event, it is quite possible that it will have some positive effect on imports in the future. That is, as the new imported products become established in the U.S. market they will continue to provide competition to domestic producers. This admonition may well be relevant to Ohio, where over 4,000 employees (or 26 percent of all employees in household appliance industries) are employed in either electric housewares or cooking equipment industries.

Exports: Major appliances take the lead in U.S. exports, as many less-developed countries do not produce these. Buyers include high income countries in the developed and/or oil-producing world: Canada, Saudi Arabia, Mexico, Venezuela and the United Kingdom. During the 1970's exports grew at a substantial pace, accounting for 4 percent of shipments

in 1972 and 10 percent in 1981. Due to the worldwide recession combined with the rising price index for U.S. appliances in 1983, however, the demand for these products dropped sharply from 1981 to 1983 and the value of exports plummeted 30 percent in two years (from $1.3 billion in 1981 to $900 million in 1983). As the rest of the world recovers from the recession, it seems likely that the demand for U.S. appliances, particularly refrigerators and automatic laundry equipment, will resume its upward trend. Since Ohio is a major producer of laundry equipment, accounting for some 7,000-plus employees (or 45 percent of Ohio's household appliance industry jobs), it could benefit from regained sales of U.S. household appliances on the international markets.

Overall Effect--Analysis

While the fluctuating balance of trade can be attributed to the cyclical fluctuations in international markets which affect both exports and, to a lesser degree, imports of household appliances, the proportion of gross trade to U.S. goods production is a structural variable which is likely to increase over the longer term. The effect of this increase, if any, on employment in Ohio will depend upon the rate of world recovery as well as the response of U.S. manufacturers to the introduction of competitive product lines in smaller appliance industries, and the overall structure of Ohio's manufacturers.

Since the (relative) strength of the U.S. economy accounts for both (increased) domestic demand as well as the (negative) balance of trade on the international market, it acts as a buffer on price-determined trade--especially exports. For example, although exports as a percentage of shipments may have decreased from 1981 to 1983, domestic demand had in

fact been increasing, and more than covers the effect on U.S producers for the decline in exports. (In fact, it is nearly 5 times as great.) However, the slow but steady rise in imports, although expedited to some extent by cyclical patterns, may prove to have more formidable structural consequences on the household appliance market over the long term.

Productivity

The increasingly saturated household appliance market, particularly in the major appliance industries, has led to progressively lower profit margins and hence provided greater incentives to reduce costs and increase productivity. The past two decades have brought an average annual productivity increase of 2.4 percent in the subsector, the highest in the electrical and electronic equipment sector. The increase in productivity have been achieved through firm consolidation, the introduction of state-of-the-art technology and direct cuts in labor costs. The following sections discuss briefly the extent and effects of consolidation and technology on productivity.

Consolidation

Both nationally and in Ohio, the trend in household appliances has been toward a small number of very large, conglomerated companies. Currently in Ohio, for example, the five largest employers in SIC 36 employ over 80 percent of the industry workforce. The larger companies have been able to maximize their efficiency and increase profit margins by applying economies of scale in production and distribution. The larger scale has also facilitated the investment in "state of the art" production technology and expansion of product lines to ensure their place in the market. In addition, some appliance manufacturers have reduced costs by assembling

their own printed circuit boards rather than purchasing them from electronic component suppliers.

Technology

The role of technology in any industry is twofold: it may increase the efficiency/effectiveness of the production process, thereby creating a shift in the production curve, or it may be used to increase the quality of final goods (or services). These two potential functions often have opposing effects on employment in that the first generally tends to lower employment while the second generates a new market and hence raises final demand for goods, thereby raising employment. During the past decade the former has played the primary role of technology in the household appliance industry. For example, the introduction of microprocessors and solid state control systems into production processes have provided flexibility in programming automated equipment that is accurate, fast and material-efficient. The automated stations are making great improvements in household appliance production lines, lowering unit labor requirements and shifting skill requirements from manual to machine monitoring and maintenance. Also, advanced painting technology such as electrostatis painting and electrocoating have become widespread in the appliance industry. Both have reduced the labor inputs required since they are more automated, and require less human handling. Robots have also been used in some installations. These processes are faster, make more efficient use of materials, reduce energy costs and produce better quality paint costs and less pollution than traditional procedures.

Forecast of Productivity

Although the major appliance industry has consistently had the highest growth rate of average annual productivity among all electrial equipment industries since 1960, the increase in productivity hasn't been constant. From 1960 to 1967, productivity grew at an annual rate of 6.1 percent, while from 1967 to 1979 the annual rate was only 3.9 percent. (This figure is even lower for the past decade--2.4 percent between 1973 and 1983.) It appears that the bulk of productivity gains from consolidation and direct cost reduction and technolgical improvements in the production process have already taken place (during 1960-1967). The deceleration in productivity gains is likely to continue unless some major technolgical innovation relating to production process occurs soon.

Summary and Conclusions

The effects of domestic demand, productivity increases and trade have been described separately in the previous sections. This section attempts to examine the interrelationships of these factors and their joint effect on employment based on the analyses of past trends at the national level. Further, this section estimates their impact on 1990 national employment and discusses the implications for employment in Ohio's household appliance subsector.

The interrelationships of these variables can be summarized by two equations:

Domestic Demand + Balance of Trade = Domestic Production

where B.O.T. = (- imports + exports)

and

(Domestic) Production = f(Productivity x Employment)

or

$$\text{Employment} = \frac{\text{Domestic Production}}{\text{Productivity}}$$

(It is assumed that the market clears in a relatively short interval and production and shipments can be considered equivalent.) For simplification of the model it is also assumed that the weekly hours/worker in the productivity term remains constant. This is not entirely accurate since the hours worked per week has declined continuously by approximately -.4 per annum since 1977.

During the past two decades or so the 4.8 percent average annual compound growth in domestic demand has combined with a slightly negative growth in the balance of trade to produce a 1.5 percent average annual increase in domestic production since 1967. The 1.1 percent average annual decline in employment between 1967 and 1982 can be attributed primarily to the increases in productivity.

Employment in this sector averaged 184.9 thousand in 1978. By 1982 it had dropped to 138.7 thousand, a loss of 46,000 jobs or 25 percent of the 1978 level. Nearly half of the decline occured in 1981. With the general economic recovery beginning in 1983, employment increased slightly to 140.2 thousand and should average about 155,000 in 1984. The increase in domestic demand beginning in 1983 has been partially offset by an increasing trade deficit as recovery in the world economy lags and exchange rates continue to favor imports.

However, with increases in productivity tapering off and a continued substantial growth in domestic demand projected over the next three to five years, the prospect for employment in household appliances looks promising.

A growth rate of 4 to 6 percent per year nationally through 1990 would be reasonable to expect.

Ohio's Outlook

Table 363.4 shows the structure of Ohio's employment by subsectors in 1982. It is not clear how this structure has shifted with respect to recent developments over the past decade. In the absence of state specific information on 4-digit SIC trends, one can look at national trends in the 4-digit SIC's and weight them accordingly in order to assess the probable direction of employment in Ohio's household appliance industry.

Ohio's industry is particularly weighted in the manufacture of laundry equipment (45.4 percent of household appliances in Ohio, as opposed to only 13.7 percent nationally). Although at a national level this industry has seen an overall decline in employment of 1.6 percent per annum during the past 15 years, several factors indicate a potential shift in this industry.

a. Decline in productivity growth. Major productivity gains were made in the 1974-1975 period after the highest industry expenditures to date for new plants and equipment in 1974 ($48.4 million). Gains in productivity since then have been considerably less and, in fact, output/hour diminished from 1979-82 despite increases in expenditures for new plants and equipment. Maximum productivity to date was achieved in 1979 when production levels were the highest since the 1972-73 boom. It may well be the case that firms have decided to hold onto employees in this recession in anticipation of greater demand in the near future. At any rate, it appears that in this industry gains in productivity have bottomed out, at least for the short term. Additional gains may

Table 363.4

Breakdown of Subsector Industries by 4-Digit SIC

SIC	# of Employees In Ohio	Percentage
363 (total)	15,755	100.0
3631	1,785	11.3
3632	725	4.6
3633	7,145	45.4
3634	3,360	15.0
3635	3660	23.2
3639	85	0.5

become evident later but it seems unlikely they will do so at the expense of employment.

b. Increasing domestic demand—Domestic demand is likely to increase through 1987 as the result of recessionary, pent-up demand, replacement of equipment purchased during the 1972-73 boom years, expected growth in new households, and increases in personal disposable income.

c. Increase in export levels—The level of exports has on the whole been increasing since 1971 when exports totaled some 41,000 units. In 1981 they wre over three times as large, with 142,000 units. The worldwide recession, as with other export markets, has dempened the international demand for U.S washers and dryers, but this situation is expected to correct itself once the international economy rebounds and catches up to the U.S.

As for the other industries, Ohio is relatively less well represented than nationally. The vacuum cleaner industry is Ohio's second largest employer in this SIC. Nationally, employment in this industry has also been keeping even, and its percentage of industry also hasn't changed drastically.

The biggest declines nationally have occurred in the refrigeration equipment industry. Ohio's percentage of household equipment for refrigeration equipment is 4.6 percent. This compares with 18.5 percent nationally in 1982, down from 24.6 percent in 1978. In this industry Ohio stands at a relative structural advantage. That is, further declines in employment are unlikely to affect Ohio greatly.

Overall, Ohio's relatively high location quotient or concentration of industry employment will be a great advantage in these projected booms over the next two to four years. Beyond this point, however, the growth in domestic demand for major appliance sectors such as laundry equipment will slow down and eventually level off. This may mean decreasing employment unless some structural shift occurs in the weighting of appliance employment relative to that of more highly demanded and less saturated products.

The BLS projections of national employment in the household appliance industry range from 175 to 193 thousand in 1990. This base projection is 185,000, about equal to the 1969 and 1978 peak levels. Ohio's share of national industry employemtn trnds to fluctuate with the level of economic activity, increasing in periods of expansion and declining in periods of contraction but has also shown some secular decline between successive peaks, moving from 18.4 percent in 1969 to 16.7 percent in 1973 and 15.3 perdent in 1977. We believe, however, that the radical drop after 1978 is primarily a short-term structural shift associated with the magnitude of the current recession.

Accepting the revised BLS projections for the national industry, we expect the Ohio share to return at least to the 1979 elvel and employment to be approximately 22,00. Employment in August of 1984f was 17,400, about equal to the 1981 average.

NOTES

[1]Calculated from figures measured in constant (1972) dollars.

[2]Donald Owens, "Microelectronics: A New Horizon for Appliances," Appliance, July 1979, pp.28-33.

[3]John Harris, Officer of Consumer Goods and Service Industries, U.S. Industrial Outlook, 1984.

[4]BCS analyst Ronald F. Kutscher in a talk presented on April 9, 1984 to National Conference on Economic Distribution of Jobs.

[5]Gross trade as a percent of final good production is calculated as:

$$\frac{\text{Merchandise imports + merchandise exports}}{\text{Sales of final goods + merchandise imports}} \times 100$$

This measure has been used by Mark Johnson, BLS economist, in his report on "Robust growth and the strong dollar set pattern for 1983 import and export prices." Data from U.S. Industrial Outlook, 1984.

[6]This ratio represents the percentage of imports to new supply, or product shipments plus imports.

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364: Electric Lighting and Wiring Equipment

This subsector accounts for 18.1 percent of Ohio's electric and electronic employment (see Chart 36.4-1) and includes: 3641, electric lamps (light bulbs); 3642, current carrying wiring devices; 3644, noncurrent carrying wiring devices; 3645, residential electrical lighting fixtures; 3646, commercial and industrial lighting fixtures; 3647, vehicular lighting equipment (headlights, etc.); and a miscellaneous category.

Ohio's employment is largest in the electric lamp (49.2 percent), current carrying wiring devices (18.5 percent), and vehicular lighting equipment (17.2 percent) industries. Because the data available on this subsector is rather sparse and generally highly dissagregate, this report will highlight relevant elements of these specific industries, particularly where subsector information (as a group) is not available.

Historical Trends

Employment in electric lighting and wiring has remained relatively constant during the past 15 years both nationally (approximately 200,000) and in Ohio (approximately 22,000) (see Charts 36.4-2 and 36.4-3). During this 15-year interval, U.S employment in the subsector has shown a gross decline of 9 percent (18,400), while Ohio's gross decline was 20 percent (4,500). Adjusting for cyclical effects (using 1972 and 1979 as comparable business cycle years due to their similar national and state unemployment rates), the shift in employment is positive for the nation (1.4 per annum) and slightly negative for Ohio (-0.61 percent per annum).

Structurally speaking, at the national level this positive rate of employment growth in SIC 364 is not as great as the overall rate of

Figure 36.4-1

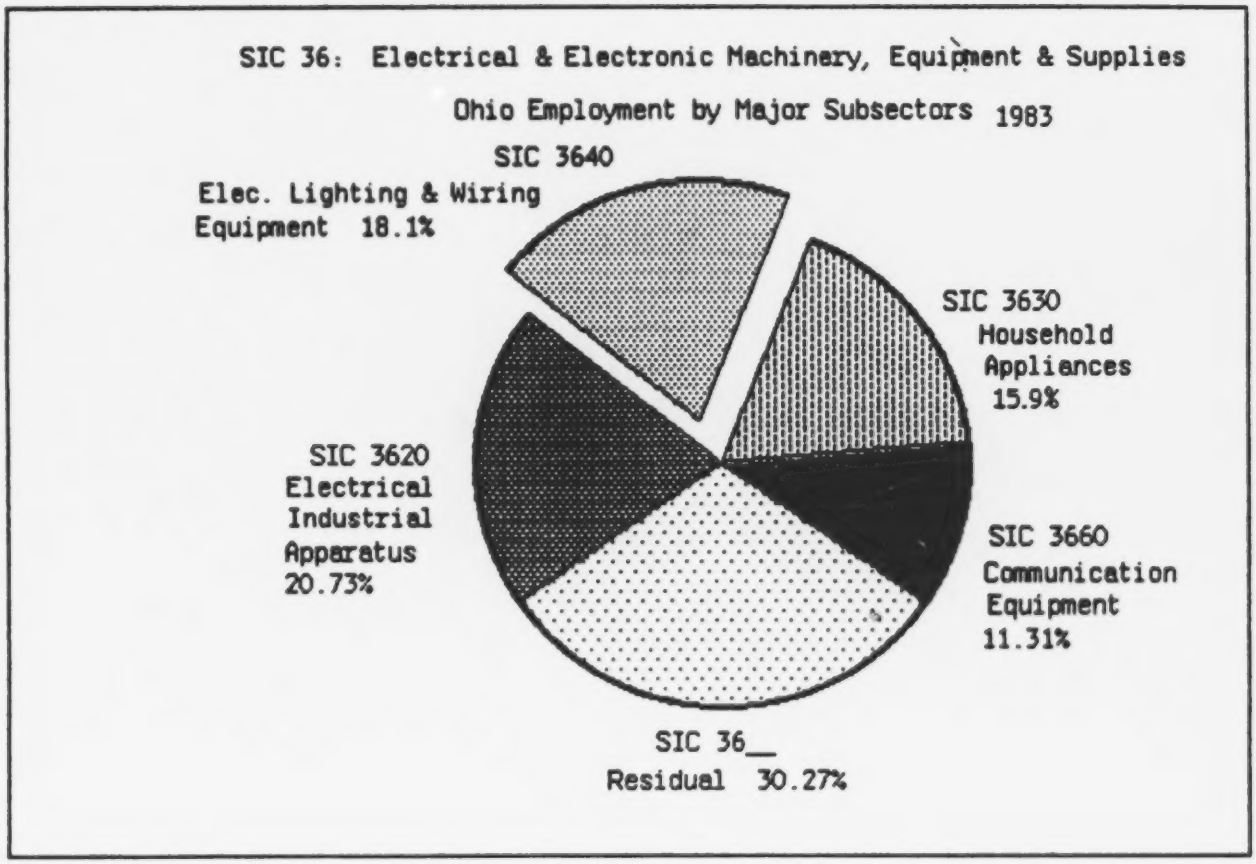

SIC 36: Electrical & Electronic Machinery, Equipment & Supplies
Ohio Employment by Major Subsectors 1983
SIC 3640
Elec. Lighting & Wiring
Equipment 18.1%
SIC 3630
Household
Appliances
15.9%
SIC 3620
Electrical
Industrial
Apparatus
20.73%
SIC 3660
Communication
Equipment
11.31%
SIC 36__
Residual 30.27%

Chart 36. 4-2
SIC 364: U.S. Employment Trends

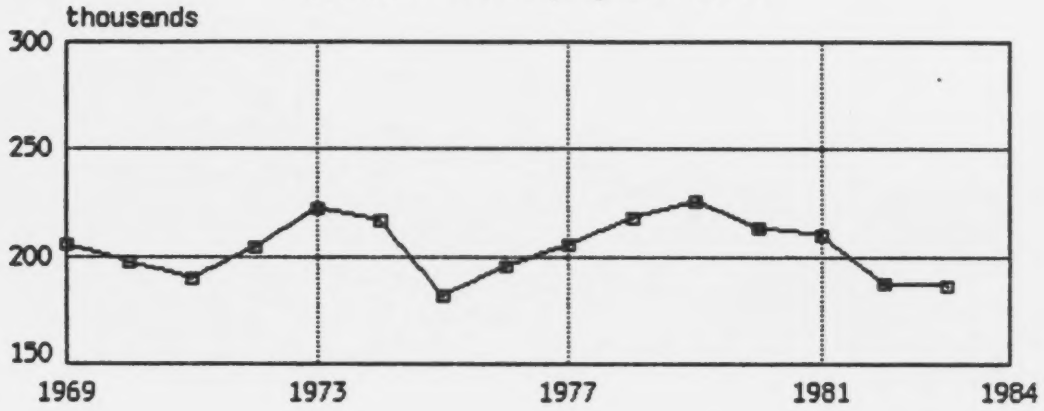


Chart 36. 4-3

SIC 364: Ohio Employment Trends

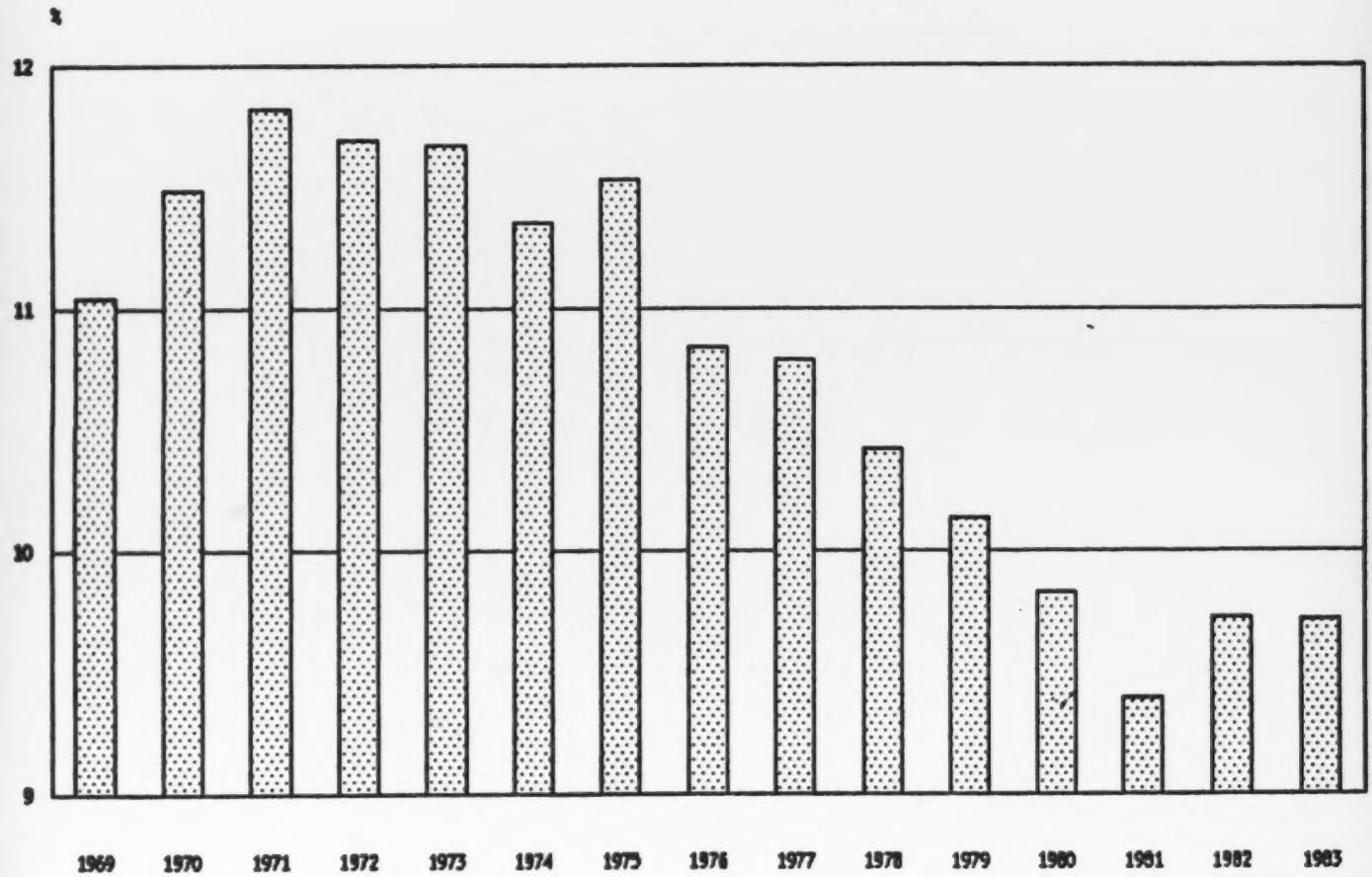
employment growth. On the other hand, the rate of decline in this subsector is not as great as the state's overall level of employment decline. Thus, Ohio's percentage of national employment has remained at around 10 percent over the past 15 years, and the concentration of Ohio's electrical and lighting and wiring equipment has remained at around two times the national concentration (see Charts 36. 4-4 and Table 36. 4-1).

Demand

Most products of the electrical lighting and wiring equipment industries are an integral part of products from other industries such as residential and commercial construction, transportation, communications, and the electrical and electronic industries themselves. These intermediate products form nearly 73 percent of the demand for electric lighting and wiring, while final demand accounts for some 27 percent of its products. Table 36. 4-2 shows the output distribution of electrical and electronic commodities among various industries as published in the Survey of Current Business. (Although these figures are based upon the 1977 input/output matrices, the overall structure of the demand is relatively stable. Therefore it is unlikely to have changed very much in the interim.) The table shows that nearly half of the total demand for products from the electrical lighting and wiring industries comes from domestic contruction. Within this group 74 percent or $2,758 million (producers' prices) comes from new construction, while 26 percent comes from maintenance and repair construction. Personal consumption expenditures account for the next largest percentage, accounting for some $1,318 million worth of business, or 16.1 percent. Transportation equipment (the bulk of which is motor vehicle equipment and "other transportation" equipment) and

Chart 36.4-4

SIC 364: Ohio's Percentage of National Employment



48

Table 36. 4-1

Location Quotient for SIC: 364

Variations from 1969-1982

1969	2.00
1970	2.09
1971	2.19
1972	2.18
1973	2.18
1974	2.13
1975	2.21
1976	2.10
1977	2.09
1978	2.04
1979	2.02
1980	2.01
1981	1.99
1982	2.16

Table 36. 4-2

The Demand for Electric Lighting
and Wiring Equipment
by Sector - 1977

			% Demand
Construction (all)		3,729	45.5
New	2,758		
Maintenance and Repair	971		
Personal Consumption		1,318	16.1
Transportation Equipment		604	7.4
Motor vehicle equipment	469		
Other transportation	133		
Electrical and Electronic Equipment		609	7.4
Radio, tv and communications	178		
Dev.	162		
Household appliances	109		
Electrical industrial apparatus	89		
Services		354	4.3
Exports		460	5.6
Imports		-240	2.9
Change in Business Inventories		361	4.4
Subtotal		7,195	87.8%
Other		1,004	12.2%
Total Demand		8,199	100.0%

Source: Survey of Current Business, May 1984, pp. 52-57.

the electrical and electronic equipment and services sector jointly contribute another 19.1.

Domestic demand in this subsector is characterized by two markets:

1. the market for new products which is highly dependent upon the rate of economic growth and technological advancement;
2. the replacement market which depends upon the overall level of product utilization and technological development.

The markets tend to differ in the nature of their customers, and in the quality of their products. The new product market generally consists of industry and government who are interested in high quality, durable products, while much of the replacement market consists of retailers interested in competitvely priced products. Each subsector industry relies to a greater or lesser degree on each of these two markets.

For example, the electric lamp industry is to a large degree a replacement industry, although the level of construction, particularly business construction (as businesses generally require a greater amount of electric lighting and wiring than residences) influence the demand for new products. Also, new cost-efficient lights, which use less energy but more technology as they replace older bulbs create a slightly greater product demand due to increasing quality.

Current carrying wiring devices such as lampholders, switches, power outlets, dimmers, florescent starters and attachment plug caps are more highly dependent on the commercial market which purchases higher quality equipment both for original product use and industrial maintenance.

The demand for motor vehicle electrical lamps come both from new and replacement markets, and depends on the number and average age of cars on the road, prices of operation and maintenance (including gasoline) as compared with suitable alternatives, and levels of disposable income.

Because the direct market of products from this industry is heavily dependent on individual private consumption, the long-term demand for motor vehicle electrical lamps is more highly susceptible to demographic factors than are other electrical lighting and wiring industries.

Short-term factors such as interest rates (for loans on new business and residential construction, or loans on new cars) also affect the short term demand for products in this subsector through the demand from industries which utilize electrical lighting and wiring equipment.

Demand Outlook

The outlook for electrical lighting and wiring equipment demand as a group (364-1, 5, 6, 7, 8) seems fairly optimistic. According to the National Electrical Manufacturers' Association, 1984 sales are expected to increase by 64 percent over 1983 figures. Technology Forecasts projects lighting equipment shipments will increase at a rate of 8 percent per year to $29 billion by 1995, as opposed to a level of $9 billion in 1980. In addition, Data Resources, Inc. lists electric lighting among 29 industries facing capacity limitations over the next 10-20 years in the United States.

The U.S. Industrial Outlook's individual industry projections for automotive (replacement) parts, which includes vehicular lamps and current carrying wiring devices are somewhat more conservative, however. They project a 2.5 to 3 percent annual increase in the demand for original auto equipment and a 4 to 5 percent growth rate for replacements in the same industry, based upon their projections of overall auto industry growth. Further, they project a 3.5 percent annual compound growth rate for current carrying wiring equipment which is based upon an expected increase in construction growth of between 2.5 to 4 percent.

While it is not clear which of these projections of demand, if any, is most accurate, the following two points can be made:

1. Demand is not likely to decline substantially over a given longer term period. The demand for replacement parts in this industry has a stabilizing effect on the absolute levels of goods produced, creating, in essence, a minimum level of demand.

2. The positive growth of demand then will depend to a large extent on overall economic growth, and particularly expenditures on new plant and equipment by all industries, as well as the ability of individual industries to keep abreast in introducing and developing technologially superior products.

Trade

The data available on trade in this subsector was somewhat limited. Historical data were available only for electic lamps (3641) and vehicular lighting equipment (3647) from Predicasts' Basebook although the various sources cited often had entirely different sets of data. The Survey of Current Business recently published commodity input/putput matrices which include export and import data for this subsector, but this is for only one year—1977. The following information has been gleaned these sources and the 1982 Census of Manufacturers reports for vehicular lighting and electric lamps. The first section describes the 1977 state of trade data in electrical lighting and wiring. The next two parts describe historical patterns in each of these two industries and attempts to assess the impact of trade on demand for domestic production.

1. Electrical Lighting and Wiring Industry: 1977

Imports: Imports of electrical lighting and wiring products represented only 2.0 percent of the total domestic production in 1977. Because of the nature of these products—many of which are intermediary and/or very inexpensive (which means that shipping costs are not worthwhile)—it is not likely that the percentage of imports will vary

greatly over the next few years. Imports compromise a somewhat larger percentage (10.74 percent) of the products produced for "final demand" in this country.

Exports: The rate of exports of electric lighting and wiring products was 5.6 percent in 1977 ($460 million). Although this is nearly double the rate of imports, it is still a relatively small amount in comparison with the percentage of exports in other sectors. The reason that products from this industry have a lower gross trade value than products of other industries is due primarily to the fact that a large proportion of them (72.7 percent) are intermediate products—that is, they are inputs into the production of other goods which constitute the final goods/services. If one looks at the remaining 27.3 percent of "final demand," however, the export percent compromises some 20.6 percent, which is relatively high.

2. Electrical Lamps (3641): Historical Trade Patterns

Imports: The percentage of imports in the electrical lamp industry has been rising since 1967. Although there has been some reversals in this trend due to cyclical patterns, the trend has persisted and can be seen as a structural one. In 1967, $22.6 million of electrical lamps were imported while in 1982 this figure had increased more than two and one-half times to $56.7 million (in real terms, using 1967 valuation). The percentage of shipments total also reflects this increase, from 3.01 percent in 1967 to 7.61 percent in 1982. It is quite likely that the trend will continue for some time to come, although without more qualitiative data it is difficult to predict what is likely to occur (see Table 36.4-3).

Exports: Exports of electrical lamps have also been increasing since 1967. In 1967 they represented 31.3 million or 4.17 percent of shipments. In 1982 they represented $55.2 million or 7.78 percent of shipments. This

Table 36. 4-3

SIC 3641: Trade

	Imports			Exports				
Year	($ mil)	(1967 $ mil)	% Shipments	($ mil)	(1967 $ mil)	% Shipments	(mil. lamps)	% Total Prod.
1967	22.6	22.6	3.01	31.3	31.3	4.17	136.5	3.18
1970	35.4	35.0	4.12	39.2	39.6	4.60	157.3	3.52
1971	41.9	40.5	4.48	36.8	38.1	4.07	143.9	3.33
1972	63.5	61.5	6.02	44.6	46.0	4.36	210.4	4.08
1973	79.2	65.9	6.88	49.6	54.6	5.18	272.4	4.81
1974	64.4	48.1	5.43	62.9	84.2	7.10	346.0	6.46
1975	56.3	34.1	4.52	49.3	81.4	6.54	434.1	8.64
1976	78.0	44.6	5.33	51.1	90.6	6.11	385.3	6.81
1977	102.8	53.3	6.31	56.0	108.1	6.64	458.2	8.27
1978	131.2	61.9	7.03	56.2	119.4	6.40	498.9	8.76
1979	146.7	63.3	7.00	66.9	155.1	7.40	714.8	11.99
1980	142.6	55.8	7.02	77.0	196.9	9.58	668.8	13.90
1981	176.7	64.7	8.43	58.7	160.3	7.65	466.3	11.00
1982	164.4	56.7	7.98	55.2	160.1	7.78	412.9	10.42

Please note: Shipment figures used for this calculation are an average of shipment figures from Annual Survey of Manufacturers and Current Industrial Reports: Electric Lamps, both from the Bureau of the Census, as presented in Predicasts' Basebook, 1983.

is an increase of 76.4 percent and 86.6 pecent, respectively. The level of exports has shown some cyclical variation, being dependent not only upon U.S. production cycles, but also on the international business cycles. One finds, for example, that the level of exports peaked in 1980 and had declined 28 percent by 1982 due to the growing strength of the dollar on the international market.

One intriguing finding in the export trade figures is that in terms of actual numbers of lamps exported, the percentage of exports (to production) rises consistently after 1974, as compared to the ratio of the value of lamps exported to total lamps shipped. Barring any large variations in the nature of inventory stockpiling, this implies that the unit price of exports has declined relative to the unit price for domestic shipments. This factor may be a result of the relative strength of the U.S. dollar on the international market and, hence, a desire for firms to remain competitive has driven export prices down.

Overall Trade Outlook

Both imports and exports have become increasingly important factors in the electric lamp industry. The ratio of imports to exports also seems to have been reasonably steady, with exports dominating in periods of domestic recession and imports being more significant in times of world recession (relative to that of the U.S.). On the balance, the net effect on domestic demand appears to be negligiable over the long term since they, in effect, cancel each other out. Because the qualitative data on this set of figures is not available it is difficult to predict any possible shifts or changes in these balance of trade trends.

Vehicular Lighting: Trade

Exports: The historical data in this industry are particularly diverse, in that the two Predicasts sources show vastly different figures for the years they overlap, as well as different trend patterns.

The CIRMA 36L source has an incomprehensible shift between 1977 and 1978 export shipment figures, and its figures for exports from 1978 to 1982 are inconsistent with other published sources (e.g., 1982 Census of Manufacturers). Therefore, the export figures used are those provided by the FT610.

Table 36. 4-4

Vehicular Lighting Equipment

Year	Exports mil $	Industry Shipments mil $	% Shipments	W.P.I.	Exports (mil 1971 $)
1975	16.87	591	2.85	125.1	17.49
1976	22.91	771	2.97	131.0	17.49
1977	27.20	909	2.99	137.3	19.81
1978	33.02	1057	3.12	156.1	21.15
1979	33.43	1061	3.15	169.4	19.73
1980	36.11	876	4.12	188.7	19.14
1981	41.74	956	4.37	219.6	19.01
1982	38.96	1011	3.85	252.9	15.41

The exports of vehicular lighting equipment, as depicted in Table 36. 4-4 show an interesting trend. While over the past decade the percentage of exports has been steadily increasing with respect to total shipments of vehicular lighting equipment (except in 1983), the value of exports measured in "real" terms, has been declining.

Imports

We were unable to find import data on this industry. Given the lack of printed information on this industry as well as the intermediate nature

of the product, it is probably safe to assume that the impact of imports is negligible.

Summary of Trade Effects

With the deficiencies in available data, it is difficult to anticipate the effect of trade on the overall demand of motor vehicle lighting equipment using trend analysis. There are, however, other trade-related factors which may affect the level and direction of demand in this industry. The passage of legislation requiring a specified minimum content of domestic labor and parts in the automobile industry could potentially benefit the vehicular lighting equipment industry. It would limit the level of imports and create an increased demand for domestic products in the automotive supplier industries. This legislation, however, would probably have less impact on the vehicular lighting equipment industry than other supplier industries, due to the apparent invisible or negligiable level of current imports. On the other hand, the expiration of the self-imposed import quotas set by the Japanese for automobiles could have a negative impact on domestic vehicular lighting equipment production if the level of auto imports increases dramatically (refer to Transportation Equipment report for further analysis on that industry).

Productivity

Productivity, measured grossly as output/employee/year and output/production employee/year, has shown roughly the same pattern over the past 15 years (see Table 36.4-5). Productivity had been increasing fairly consistently until 1979 when it dropped pricipitously with decreased demand due to the recession and a desire by employers to "hang on" to employees until the end of the recession. Thus, 1983 productivity figures should show some increase in the level of productivity. It is interesting

Table 36. 4-5

SIC 3641: Electric Lamps
Productivity

Year	Production (in mils.)	Total Employment (in 1000's)	Gross Productivity O/T.E.	Production Employment (in 1000's)	Production Productivity O/P.E.	Ratio PE/TE
1967	4,291	36.5	117.6	32.2	133.26	.926
1970	4,469	38.1	117.3	33.8	132.2	.887
1971	4,320	38.7	111.6	34.2	126.3	.884
1972	5,160	40.6	127.1	36.0	143.3	.887
1973	5,662	44.1	128.4	39.3	144.1	.891
1974	5,356	41.5	129.1	36.5	146.7	.880
1975	5,022	35.4	141.9	30.9	162.5	.873
1976	5,662	36.7	154.3	32.1	176.4	.875
1977	5,543	37.7	147.0	33.0	168.0	.975
1978	5,698	37.4	152.4	32.8	173.7	.877
1979	5,964	38.0	156.9	33.6	177.5	.884
1980	4,812	36.1	133.3	31.8	151.3	.881
1981	4,241	32.5	130.5	28.4	149.3	.874
1982	3,962	30.0	132.1	26.4	150.6	.877

that in at least two instances where there has been a decline in employment in one year (for example, 1974-5 and 1977-8), the following year when demand increased and brought a small change in employment and a major change in productivity. Production data (number of units) were not available for the other industries in this subsector. However, the "value of production" could be obtained from the available figures on value of shipment and inventories. Dividing by the wholesale price index and finally by employment gave a slightly different indicator of productivity: the "real" value of product produced by worker per year (see Tables 36.4-6 and 36.4-7).

For electric lamps, the table shows that productivity, as measured in this way, has varied extensively. High points in productivity occur in 1972, 1978 and 1979 when the economic conditions were favorable and plants undoubtedly worked at higher capacities.

Interestingly, both measures of total employment and production workers show a similar pattern of productivity trends (cyclical). As with the productivity measures used earlier, when output is measured in terms of number of units per hour, there is a substantial increase in productivity over the 15-year period between 1967 and 1982 (24.2 percent increase). Since the number of hours worked per employee has remained relatively stable (with minor fluctuations), this indicates a decline in the real price per unit produced in the marketplace for this decade and a half.

While it is clear that the two measures of productivity are not completely comparable, it is not clear what value the productivity measured as "value of product produced per employee" will have in the overall analysis. However, for the sake of completeness, historical patterns are

Table 36.4-6

Calculation of Productivity in the Electric Lamp Industry

Year	Change in Inventory (LY-TY)	Shipments (mil $)	Production Curr.$	Production 1967 $	Employment (000's worker)	Productivity All Workers	Productivity Prod. Workers
1967		782	782.0	782.0	36.5	21.4	24.3
1970	-22.5	892	869.5	831.3	38.1	21.8	24.6
1971	-4.9	962	957.1	842.5	38.7	21.7	24.6
1972	1.0	1096	1097.0	936.0	40.6	23.1	26.0
1973	2.3	1141	1162.3	967.0	44.1	21.9	24.6
1974	5.2	1188	1193.2	890.4	41.5	21.5	24.4
1975	-7.7	1212	1204.3	727.2	35.4	20.5	23.5
1976	-8.4	1478	1469.6	827.0	36.7	22.5	25.8
1977	-21.7	1651	1629.4	842.1	37.7	22.3	28.5
1978	5.1	1903	1908.1	888.7	37.4	23.8	27.1
1979	-25.4	2117	2091.6	825.7	38.0	23.3	26.5
1980	9.9	2025	2034.9	782.4	36.1	21.7	24.6
1981	-8.5	2010	2001.5	721.6	32.5	22.2	25.4

Sources: Annual Survey of Manufacturers and Employment and Earnings, Bureau of Labor Statistics, as cited in Predicasts' Basesbook, 1983.

Table 36.4-7

Calculation of Productivity in the
Current Carrying Wiring Equipment Industry

Year	Change in Inventory (LY-TY)	Shipments (mil $)	Production		Employment		Productivity	
			Curr.$	1967 $	Total	Prod.	All Workers	Prod. Workers
1967		837	837	837				
1970	-51.2	1009	1060.2	996.4				
1971	5.4	987	992.4	906.3				
1972	38.1	1256	1294.1	1172.2	79.9	58.5	14.7	20.0
1973	50.4	1443	1493.4	1328.6	88.5	64.4	15.0	20.6
1974	85.4	1777	1862.4	1489.9	87.2	62.2	17.1	24.0
1975	-104.3	1247	1142.7	793.2	70.7	48.7	11.2	16.3
1976	46.1	1682	1728.1	1178.8	76.6	54.4	15.4	21.7
1977	10.7	1795	1805.7	1171.7	82.3	58.4	14.2	20.1
1978	6.1	1893	1899.1	1151.7	88.1	62.3	13.1	18.5
1979	106.8	2454	2560.8	1431.4	91.0	63.9	15.7	22.4
1980	0.4	2603	2603.4	1290.7	86.7	60.3	14.9	21.4
1981	44.9	2762	2806.9	1274.7	83.4	56.8	15.3	22.4
1982					77.9	51.4		

Sources: Annual Survey of Manufacturers and Employment and Earnings, Bureau of Labor Statistics, as cited in Predicasts' Basesbook, 1983.

described for the two other industries relevant for Ohio: current carrying wiring equipment and vehicular lighting equipment.

Again, the productivity trends for total employees and production workers alone follow essentially the same pattern. Productivity for both peaks in 1974 and declines sharply in 1975. Basically, however, the real value of product produced yearly per employee in this industry has remained the same since 1972. Productivity, when measured in constant dollars (using 1971 wholesale price index for this industry) shows a net decline between 1983 and 1981 (and apparently 1982) of 12.6 percent. Productivity reached a peak in 1977 and seems to have been declining since that time.

Ohio Outlook and Summary

As a part of the electrical and electronic equipment sector, electrical lighting and wiring equipment plays a more prominent role in Ohio (19.2 percent) than in the U.S. as a whole (9 percent). The composition of industries (4-digit) within the subsector is also somewhat different at the state and national levels. (See Table 36.4-8.)

In Ohio, the major industries are electric lamps (SIC 3641: 49.2 percent), current carrying wiring devices (SIC 3643: 18.5 percent) and vehicular lighting equipment (SIC 3647: 17.2 percent). The employment distribution by industries at the national level shows the greatest percentage in current carrying wiring equipment (41.9 percent), electrical lamps (16.1 percent) and residential lighting fixtures (11.9 percent). Vehicular lighting equipment accounts for only 6.4 percent of SIC 364's employment nationally. Ohio employs nearly 30 percent of the nation's workers in electric lamps 9SIC 3641) and vehicular lighting equipment (SIC 364). In the remaining five industries, Ohio employs between 3 and 6 percent of the nation's workforce. Therefore, it is reasonable to assume

Table 36.4-8

SIC 364: Electrical Lighting and Wiring Equipment
Ohio vs. U.S.

4-Digit SIC		% of Ohio's Sector	% of National Sector
3641	Electric lamps	49.2	16.1
3643	Current carrying wiring devices	18.5	41.9
3644	Noncurrent carrying wiring devices	4.4	9.8
3645	Residential electric lighting fixtures	3.6	11.9
3646	Commercial, industrial and institutional lighting fixtures	5.6	8.3
3647	Vehicular light equipment	17.2	5.9
3648	Lighting equipment n.e.c.	1.7	6.4
	TOTAL	100.2%	100.3%

that nationally determined patterns are most likely to be applicable to Ohio in these first two industries. We shall therefore summarize our findings for each of the two industries separately and describe their implications for Ohio's employment.

Overall Outlook--Electric Lamps

The domestic demand for electic lamps is anticipated to increase at a relatively healthy rate over the next decade (approximately 8 percent per year). Since trade in this industry appears to balance itself out, this is not likely to be a major factor in determining the overall structure of demand for domestic production. (This assumes, of course, a recovery in the world economy that would put the strength of the dollar back into a reasonable relationship with other currencies).

The persistent increases in productivity which have held employment growth down even in the peak production years of 1979 and 1976 are not likely to stop very soon. Thus, it is not clear that increased demand will have any major long-term impact on employment in this industry, at either the national level or in Ohio.

Overall Outlook--Current Carrying Wiring Equipment

Based upon a positive prospect for construction--residential and commercial, the primary consumers of products in this industry--we can expect a reasonably strong growth in the demand for current carrying wiring equipment over the next seven years. Trade figures are not available, and it seems reasonable to anticipate that exports and imports are not a major factor in the demand for domestic production of these products. Again, with only "value of production" figures, it is difficult to assess the impact of productivity increases in the industry. More than likely they have had some impact since employment has fluctuated with business cycles

and increased only by about 12 percent in the 1972 to 1979 interval. Thus, while productivity gains may well take away some jobs in this industry, it is more likely that new demand will remain high and stimulate employment growth in this industry through 1990.

Overall Outlook--Motor Vehicle Lighting Equipment

The outlook for domestic demand for motor vehicle lighting equipment is of course highly dependent upon the domestic automobile market outlook. Based upon that industry's projection (Sector 37 of this report), we anticipate a moderate increase in domestic demand for automobiles, and, hence, for motor vehicle lighting equipment. Again, the impact of trade in this industry is minimal, and is not anticipated to change drastically in the foreseeable future. Trade in the auto industry, however, will affect the demand for motor vehicle lighting equipment indirectly, through its impact on the demand for U.S produced automobiles.

Productivity, in terms of of the value of output per worker per year has increased and decreasd over the 1967-1982 period. At the same time, employment levels have increased to 18,800 workers nationally in 1978 and 1979. This is higher than at any point previously. Therefore, although productivity increases may have had some impact on employment levels in this industry, it appears that cyclical events have been dominant. Therefore, based on projected strong increases in demand, we can anticipate a substantial increase in employment in the next decade in motor vehicle lighting equipment.

Summary

While the paucity of adequate data makes the impact of various qualitative factors on employment in Ohio's electrical lighting and wiring equipment industries, we can make some observations.

1. The outlook for motor vehicle lighting equipment and for current carrying wiring equipment which together comprise approximately 36 percent of the employment in this subsector looks reasonably promising for the projection period.

2. The outlook for electric lamps, because of large productivity increases, does not appear to be as optimistic, despite the forecasted increases in demand. This industry comprises nearly half of the subsector employment in Ohio.

The net result will probably be a moderate increase in employment in electric lighting and wiring equipment in Ohio.

REFERENCES

OES, Employment Growth Measures

OES, Economic Base Measures

OES, DASIE generated employment figures.

Survey of Current Business input/output tables. (May1984), pp. 48-79.

USA Today, Thursday August 16, 1984.

SIC 366: Communications Equipment

The communication equipment industry in Ohio accounted for some 10,200 workers or 11.3 percent of Ohio's electrical and electronic equipment machinery workforce in 1983 (see Figure 366.1). Nationally, in 1983 the figures are 479,900 out of 2,045,000 or 28.4 percent of the electric and electronic equipment workforce (see Figure 366.2). Clearly, this subsector is not currently as important in Ohio as it is in the rest of the country. In fact, its lower than unit location quotient indicates that Ohio has been a "net importer" of products produced in this industry in at least the past 15 years.

This subsector includes two four-digit categories: 3661: telegraph and telephone apparatus, and 3662: radio and television transmitting, signaling and detection equipment and apparatus. The latter includes not only radio and tv broadcasting equipment, but also electric communications equipment and parts (except telephone and telegraph); electronic field detection apparatus, light and heat emission operating apparatus, navigational electronic equipment and missile control systems; high energy particle accelerator systems as well as parts for such systems used in radiation therapy and research. It does not include radio and tv receivers and other electronic equipment for home use (SIC 365), nor electronic transmitting tubes (SIC 3673).

While historically and to some extent theoretically these two subsector categories are distinguishable, in present practice technological innovations have expanded the realm of each so that they overlap considerably, particularly in the areas of mobile radio, fiber optics and

Figure 366.1

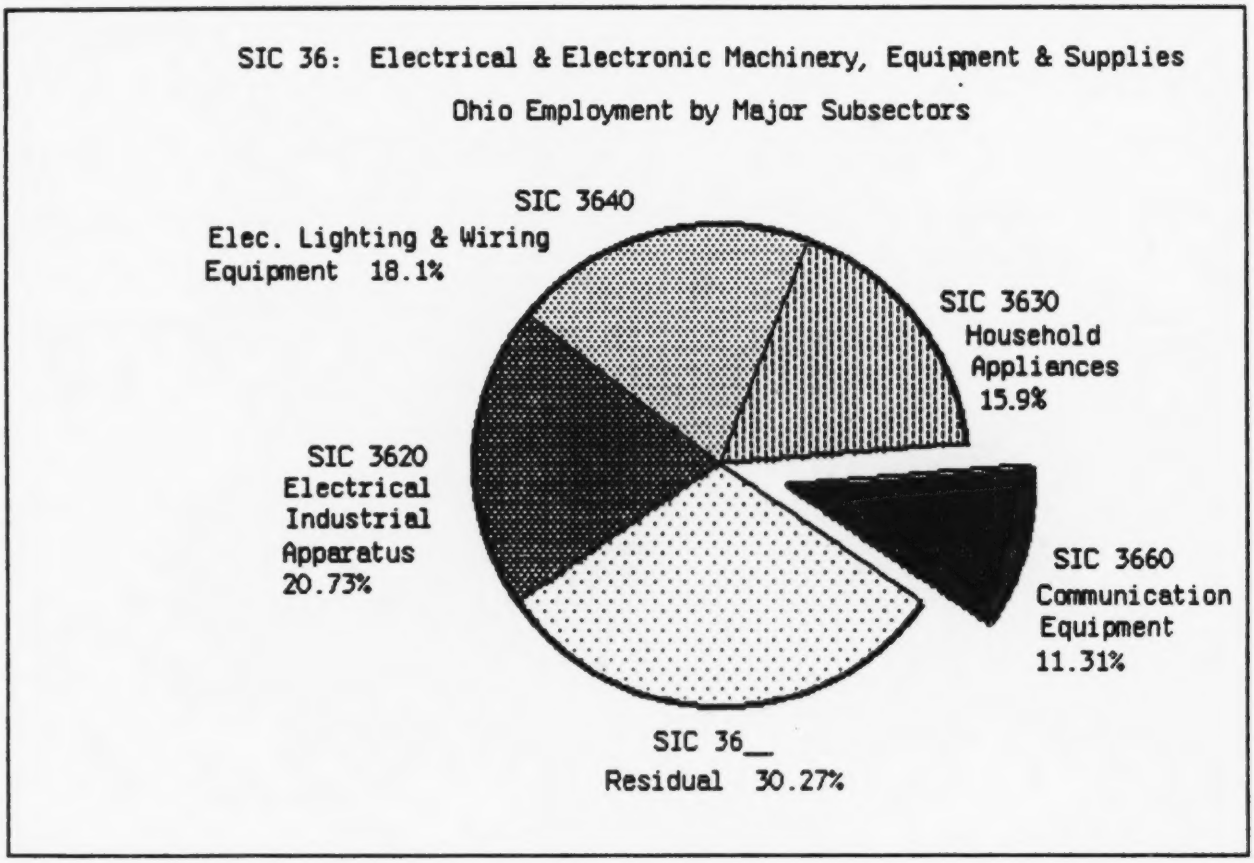
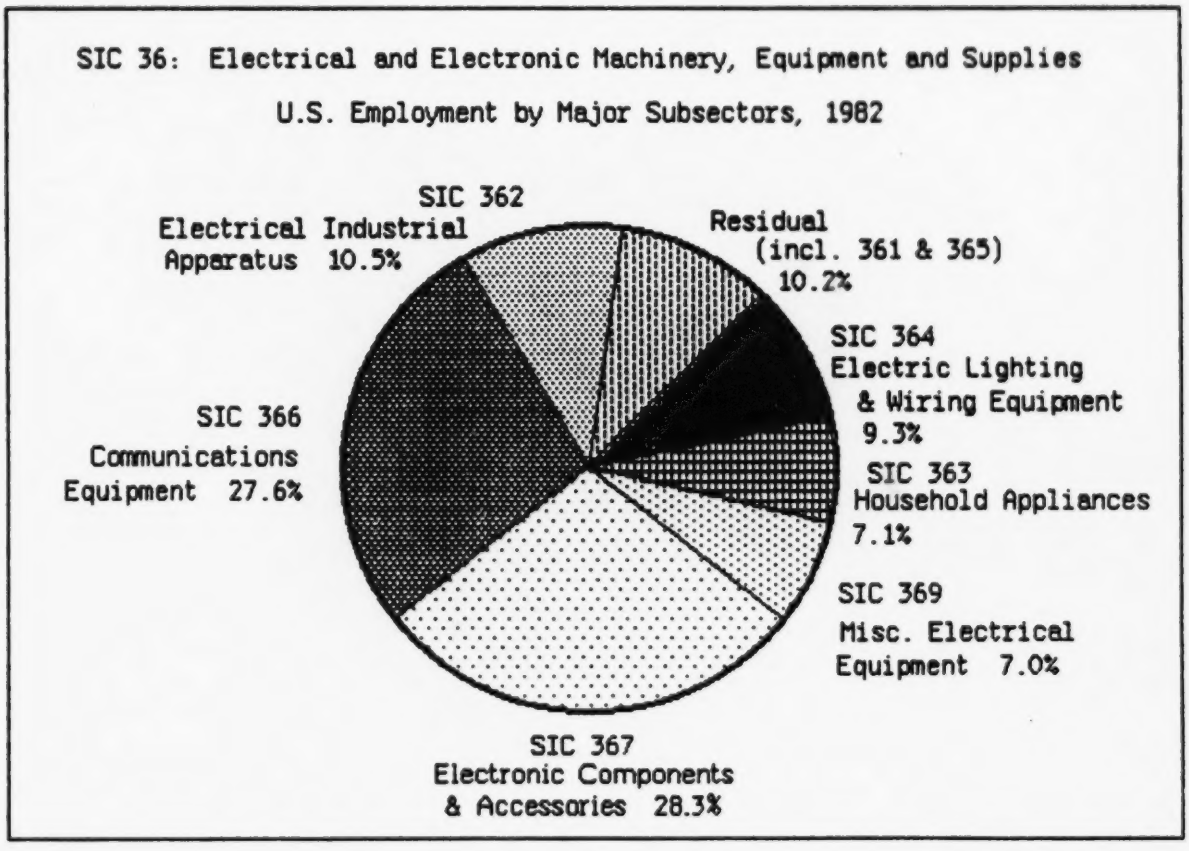

SIC 36: Electrical & Electronic Machinery, Equipment & Supplies
Ohio Employment by Major Subsectors
SIC 3640
Elec. Lighting & Wiring
Equipment 18.1%
SIC 3630
Household
Appliances
15.9%
SIC 3620
Electrical
Industrial
Apparatus
20.73%
SIC 3660
Communication
Equipment
11.31%
SIC 36__
Residual 30.27%

Figure 366.2


SIC 36: Electrical and Electronic Machinery, Equipment and Supplies
U.S. Employment by Major Subsectors, 1982
SIC 362
Electrical Industrial
Apparatus 10.5%
Residual
(incl. 361 & 365)
10.2%
SIC 364
Electric Lighting
& Wiring Equipment
9.3%
SIC 363
Household Appliances
7.1%
SIC 369
Misc. Electrical
Equipment 7.0%
SIC 367
Electronic Components
& Accessories 28.3%
SIC 366
Communications
Equipment 27.6%

fascimile and satellite equipment. Technological innovation is further blurring the bounderies of this and other sectors and subsectors, such as electronic and computer equipment. Nevertheless, the present study works to the extent possible within these categorical descriptions, partly because of the absence of an accepted more appropriate one, and partly to maintain a consistency with the historical and continuing industry data available.

In Ohio the telecommunications industry (SIC 3661) accounts for just over 70 percent employment, while radio and tv and other communications equipment (SIC 3662) accounts for nearly 30 percent. At the national level, the reverse is true.

Table 366.1

Breakdown of Employment Between Subsector Industries

SIC	Ohio Number	Ohio %	U.S. Number (1000's)	U.S. %
3661 Telecommunications	8302	71.1	157.5	28.3
3662 Other Comm. Equipment	3374	28.9	399.3	71.7
	11676	100.0%	556.8	100.0%

Sources: Ohio Occupational Employment Statistics Project and Predicast's Basebook, 1981 (figures comparable with 1981 employment for Ohio).

The telecommunications industry is characterized by a few very large corporations that account for most of its employment. Nationally, four companies employ 90 percent of the workers in this industry while in Ohio two companies employ 87 percent of its workforce. The other four-digit SIC has a much more diverse distribution of employment among firms, owing to the broad range of products/industries it in fact covers. Nationally, the four largest firms accounted for 20 percent of total product shipments in

1977, while some 1,149 (54 percent) employed 20 or less employees. Ohio portrays much the same story. The two largest firms account for only 52 percent employment in this set of industries while 73 percent of firms employ 60 workers or fewer, and 35 percent have 20 workers or less.

Employment: Historical Trends

Historically, employment in communications equipment has fluctuated around 500,000 since 1969, showing a net increase of 28,500 in the 14-year period. Between 1972 and 1979 (the two years with comparable business cycle effects on employment) employment in SIC 366 increased by 67,700 or 14.8 percent. The growth has continued in recent years despite the economic recession and declines in employment in other sectors of the economy (see Figure 366.3).

In Ohio, the employment trends have been quite different, however. Employment in this subsector has been declining at a steady pace since 1970, when it peaked at 22,000 workers. The 1972-79 period decline was 4,300 or 24.6 percent (see Figure 366.4). As one might expect, Ohio's share of the national communications employment has declined to less than half its 1979 level (see Figure 366.5).

In order to assess the future of these trends nationally and in Ohio, let us explore the effects of domestic demand, international trade and technology in shaping the future of this industry.

Domestic Demand

The domestic demand for products of the communications equipment industry has been growing at an average annual rate of 6.5 percent since 1972. This average rate is expected to be even greater by the end of 1984 (6.7 percent). Figure 366.6 depicts this strong growth curve for domestic

Figure 366.3
SIC 366: U.S. Employment Trends

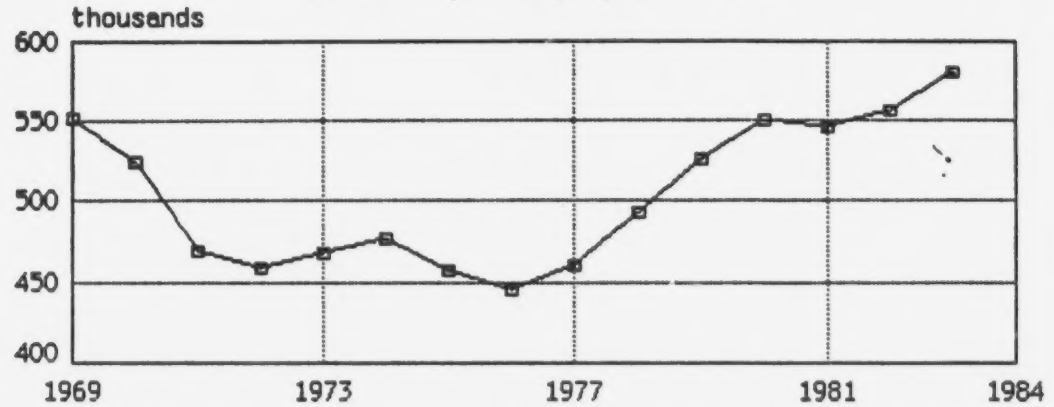


Figure 366.4
SIC 366: Ohio Employment Trends

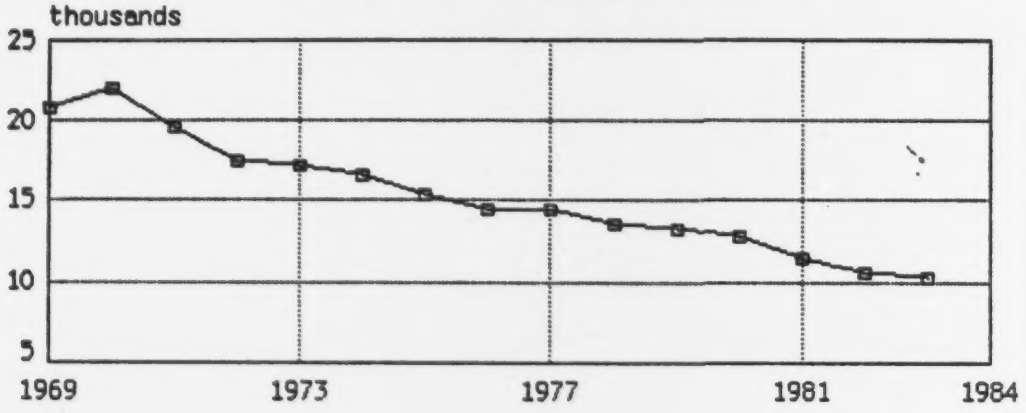
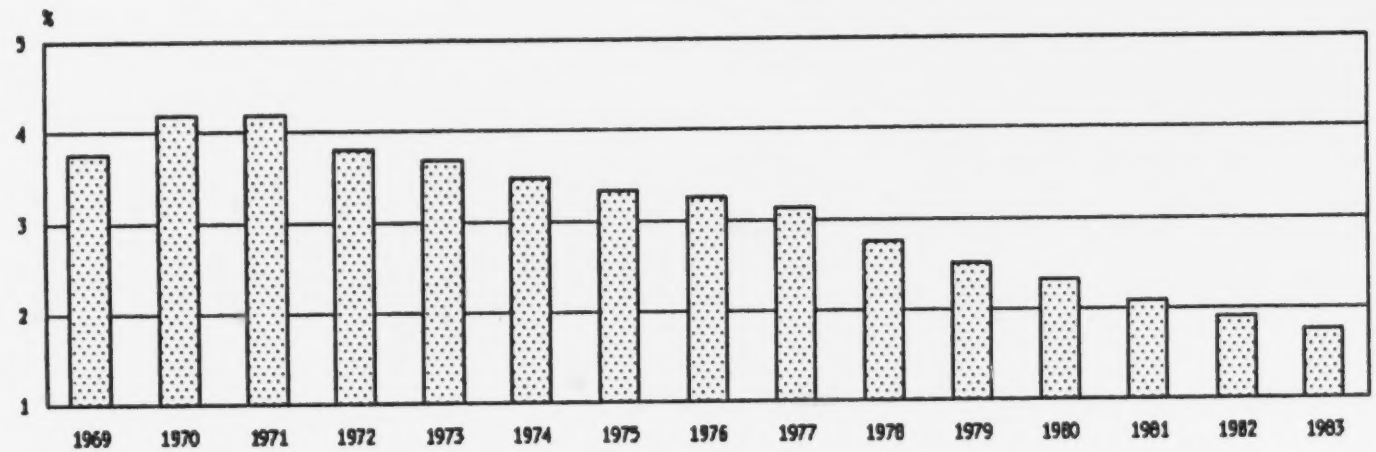


Figure 366.5

SIC 366: Ohio's Percentage of National Employment



demand and for total industry shipments, showing only minor setbacks in the growth rate during the recessions of 1975 and 1980-82.

Demand for products from the telecommunications equipment industry comes from two markets: the communications carrier equipment and the consumer premises equipment market. The former includes digital switching systems and fiber optic transmission equipment while the latter includes PBX, key systems and telephones for business, telephone answering machines, cordless telephones and telephone clock radios for private consumers.

Demand for radio and television communications equipment is generated primarily from the government, in particular from the Defense Department. Areas of growth in consumer applications include citizen band radios, automatic garage door openers and security systems. Table 366.2 provides a summary of the users of products/commodities from the communications equipment industry as a whole.

The demand for finished products from the communications equipment industries comes from private fixed investment, personal consumption expenditures and national defense. Exports also play a significant role, but they will be treated in the Trade section. Demand for intermediate products from this subsector come primarily from the communications equipment and services and from transportation equipment, especially aircraft and parts (see Table 366.3 for a breakdown of demand).

Structural Factors in Demand

Several factors account for the continued high growth in demand of communications products over the past decade or so, and for its anticipated future growth. Foremost among these is the explosion of technological advancements in the industry--both in telecommunications and in radio and

Table 366.2
SIC 366: Communications Equipment
Calculations of Domestic Demand
(in $ billions)

Year	Industry Shipments	Ind. Ship. 1972 $	Exports	Imports	Domestic Demand[1]	1972 Multiplier[2]	Domestic Demand 1972 $
1972	13.66	13.66	.685	.342	13.32	1	13.32
1977	22.74	16.19	1.647	1.336	22.42	.71	15.96
1979	30.30	20.95	2.229	1.260	29.33	.69	20.28
1981	40.32	24.88	2.958	2.236	39.60	.62	24.44
1982	43.97	25.08	3.231	2.648	43.39	.57	24.75
1983	48.09	26.82	3.345	3.115	47.86	.56	26.69
1984	—	29.09	3.575	3.500	—	—	28.97
CRG 1972-83	12.1%	6.3%	15.5%	22.2%	12.3%	—	6.5%
CRG 1972-84	—	6.5%	14.8%	21.4%		—	6.7%

[1]Domestic Demand is calculated :
Value of Industry Shipments - Exports + Imports = Domestic Demand

[2]1972 Multiplier is the ratio of shipments measured in 1972 $ to (nonadjusted) industry shipments. It is used to derive domestic demand in real (1972 $) terms.

Source: Figures for industry shipments (including 1972 figures), exports and imports are caluclated from data presented for SIC 3661 and 3662 in U.S Industrial Outlook, pp. 28-6 and 29-3. Original source: Bureau of the Census and Bureau of Industrial Economics.

Table 366.3

Demand for Products from SIC 366:
Communiations Equipment Industries

		% Total
Communications Industries Equipment and Services	2905	10.25
Transportation Equipment	2075	7.32
Other Intermediate Use	1856	6.55
Total Intermediate Use	6836	24.13
Personal Consumption Expenditures	8328	29.39
Gross Private Fixed Investment	10620	37.48
Federal Government--Defense	4395	15.51
Exports	2498	8.81
Imports	(-5716)	-20.17
Other Final Demand	1372	4.84
Total Final Demand	21497	75.87
Total Commodity Output	28333	100.00

Source: Survey of Current Business, May 1984, Table 1: Use of Commodities by Industries, 1977, pp. 52-7.

tv communications. For example, the introduction and improvement of digital switching and transmission systems in the telecommuncations equipment business stimulated demand for an entirely digitalized Integrated Services Digital Network (ISDN) to replace the current equipment. U.S. Industrial Outlook estimates that by 1990, 90 percent of all short distance metropolitan facilities will be digital, from an estimated 55 percent in 1984. This in turn will increase the demand for the more efficient time division digital switches, digital T carrier systems and digital radio systems. Improvements in lightwave technology and manufacturing using lasers promises to transmit lightwaves for longer distances through glass fiber without complications of transforming or regenerating devices. The development of fiber optic systems for carrying telephone conversations has increased capacity while reducing costs of telecommunications.

Developments in microelectronics hardware and software are making a greater number of new goods and services available to customers. New telephones include such features as speed calling, automatic dialing, electronic calendar and add-on modules and software that provide additional features and services to users.

The radio and television communications industries abound with further examples of technological innovations which stimulate demand. Mobile radios have been used since 1946; their growth, however, was limited due to a limited number of radio frequencies. The advent of cellular radio, which through advanced switching techniques allows multiple use of the same frequency without interference in a given area, has expanded the potential market for this form of communication. Some experts believe shipments of cellular radio equipment will exceed $1 billion by 1988.1 The growth of

satellite communication systems, cable television, fiber optic systems and electronic alarm systems as well as high-technology military electronic equipment such as infrared bomb guiding systems and laser-based rangefinders and designation systems have all developed due to the expansion of technology. The net effect of these developments in technological innovations has been to stimulate growth in domestic demand through introduction of new products that cut costs, increase services and speed up communication networks.

A second factor is the impact of recent legislation on the structure and the level of demand itself. Until recently, the telecommunications services industry and its captive equipment manufacturing arm has been a regulated oligopoly. Telecommunications equipment was produced by either the captive equipment manufacturing and distribution arms of the small number of telephone companies, or by independent suppliers who made equipment to telephone company standards. The equipment was marketed by a small number of firms in conjunction with service. Deregulation of the industries and divestiture of AT&T has changed this structure. The deregulation of the telecommunications equipment industry began in 1968 with the Carterfone Decision which allowed customers to attach non-telephone company equipment to telephone lines, and was strengthened by the 1975 FCC decision to certify equipment for direct connection to telephone lines. Since then, revenues of competitors in telephone terminal equipment have increased from $0 to $2 billion in 1983. This growth has come in large part from sales of PBX equipment, key systems and respective telephone sets to busienss customers, and telephone answering machines, cordless telephones and telephone clock radios to consumers.

Economic theory tells us that in moving from an oligopoly to an open market the overall level of output will increase due to competitors each trying to increase their share of the market. This should occur as long as firms realize a larger than average profit by entering this market and some equilibrium is reached. In practice, the effects of increased competition have combined with the rapid technological advancement in the field generating new demand through the expansion of products and services, the reduction of costs both in manufacturing and of product use; and the use of increased advertising and better distribution via mss retailing to make the new products easily accessible to consumers.

Although some individual companies such as Western Electric which have had a lion's share of the market stand to lose some of the percentage of the new communications equipment market, the industry as a whole stands to increase its share of GNP. Competition and technological "shift" have caused upheaval in the structure of the industry, doing away with large "integrated" companies in favor of a larger number of more highly specialized, technologically advanced competitive firms.

A final structural factor affecting demand is the increasing cost of energy and its relative use in communications versus transportation industries. As technological developments make new communication equipment available and reduced costs make it more accessible, the demand for video and audio teleconferencing and modular equipment, automatic remote meter readers, and broadband intelligent terminals (which can be operated from home) will continue to increase.

Summary of Demand

In summary, the prognosis for domestic demand in communications equipment is positive. Although the rapid expansion of demand for telecommunications equipment as a result of increased competition will settle down as new and old firms establish new niches, the expansion of products and reduction of costs due to technological advancements in both subsector categories will result in a continued growth in demand for the projection period. The U.S. Industrial Outlook projects an average annual growth rate of 5 percent plus for the next five years in telecommunications, and an 8 percent growth rate in radio and television communications equipment through 1988.

Trade

Gross trade in communications equipment climbed from 7.33 percent in 1972 to 12.43 percent in 1977, and has wavered around this level since then (see Table 366.4).

Imports: Imports have been expanding at an average annual rate of 16 percent between 1972 and 1983. In 1983 they accounted for 6.1 percent of new supply, an increase of nearly four percentage points since 1972. The growth curves for the two categories are considerably different, though their combined effect indicates a somewhat more stable curve. The average annual rate of (real) growth in telecommunications industry imports was 14.1 percent from 1972 to 1982. From 1982 to 1983 the import rate jumped to 64.4 percent (real value based upon 1972 dollars). This large influx of imports between 1982 and 1983 was no doubt due to the deregulation mandated by the FCC in its Computer II ruling in October 1981 and divestiture of AT&T by consent decree issue in 1972. The deregulation opened up the

Table 366.4

Trade in Communications Equipment

Year	Exports ($ mil)	Imports ($ mil)	Shipments ($ mil)	Gross Trade[1]	Exports/ Shipments	I/N.S.[2]
1972	685	342	13660	7.33	5.0	2.4
1977	1657	1336	22740	12.43	7.3	5.5
1979	2229	1260	30300	11.06	7.4	4.0
1981	2958	2236	40320	12.21	7.4	5.3
1982	3231	2648	43970	12.61	7.3	8.7
1983	3345	3115	48090	12.62	7.0	6.1
1984	3575	3500	56050	11.88	6.4	5.9
GR[3] 1972-84	14.8%	21.4%	12.5%	4.1%	2.1%	7.8%
GR[3](72$) 1972-84	8.7%	14.9%	6.5%			
GR[3](72$) 1972-83	9.6%	16.0%				

[1]Gross trade is the ratio of exports plus imports to new supply.

[2]New Supply (N.S.) is the sum of shipments and imports.

[3]Growth Rate (GR)--average annual compound growth rate.

Source: U.S. Industrial Outlook, 1984. Bureau of the Census and Bureau of Industrial Economics.

equipment market to competition, including competition from foreign firms. The divestiture was scheduled for January 1, 1984 and it is quite likely that the affected telephone companies delayed expansion programs (which would make them more competitive) until after the divestiture took effect. It is also probable that the relative strength of the U.S. dollar had a favorable effect on imports in this industry as it has in other industries (see Figure 366.8).

Switching systems and telegraph equipment from Japan, cordless telephones from the Far East and other telecommunication equipment from Canada accounted for most of the increased demand. Imports of radio and tv communication equipment, on the other hand, shows a different pattern of growth (see Figure 366.9 and 366.10). Between 1972 and 1982 imports in these industries grew at an average annual rate of 16.8 percent, using 1972 constant dollar values. (The peak in imports in 1976 was caused by a strong but short-lived consumer deamnd for CB radios.) Between 1982 and 1983, however, real value of imports (measured, again, in 1972 dollars) actually declined by 5.6 percent. Radio apparatus and parts, cable TV equipment and other television apparatus and parts, television cameras and parts and sound signalling equipment and parts accounted for 82 percent of the total 1983 imports. Japan, Mexico, Taiwan, Canada and Malaysia supplied nearly 80 percent of all radio and television communication equipment imports.

It appears that the import of products of the radio and television communication equipment industries is more dependent upon levels of (personal) disposable income and subject to cyclical variations in tastes and fashions than are those of the telecommunication equipment industry.

Figure 366.7

Trends in Industry Shipments and Domestic Demand for Communications Equipment (SIC 366)

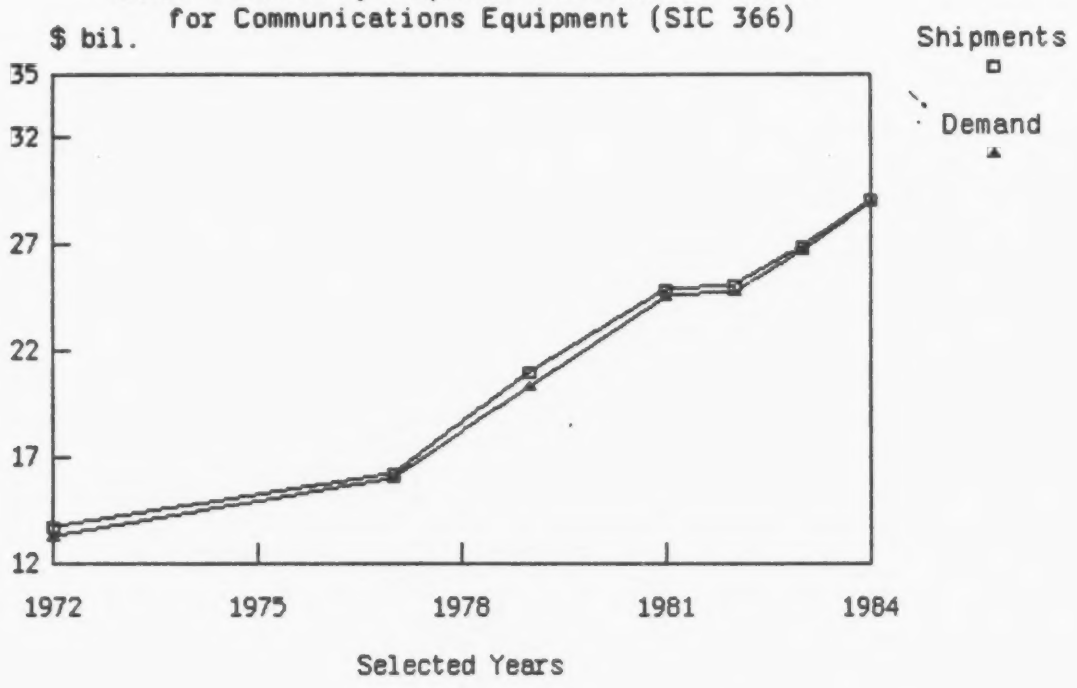
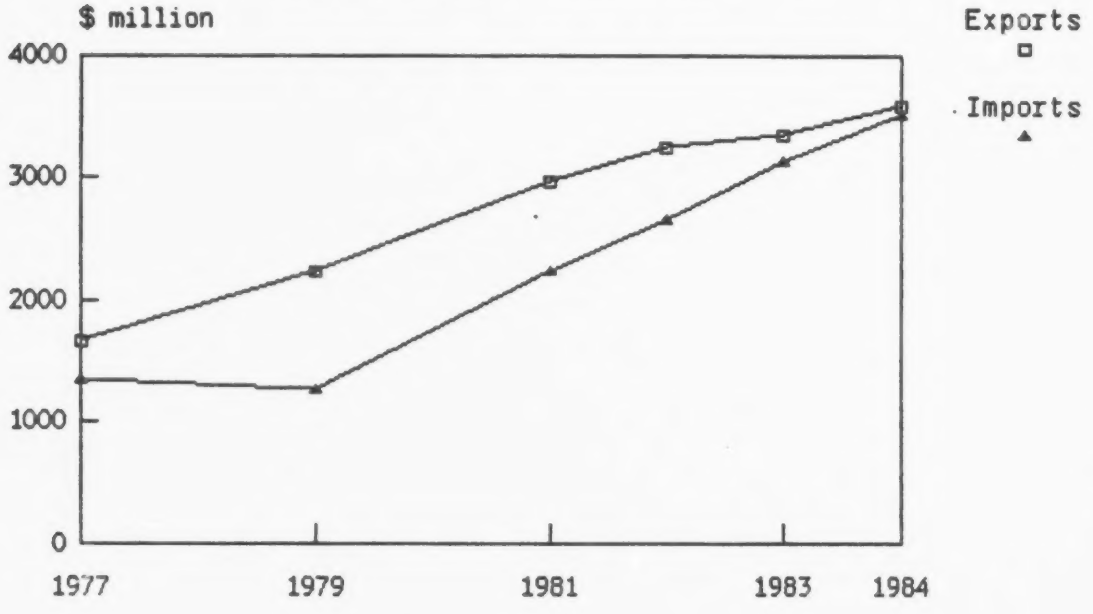


Figure 366.8

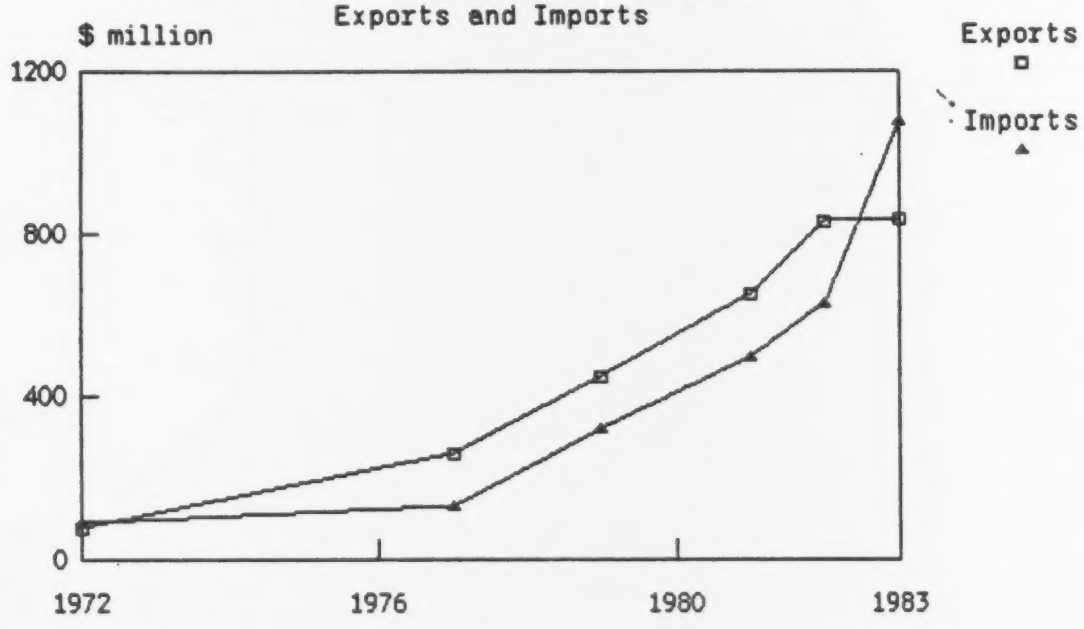
Communications Equipment: Exports and Imports



Sources: Bureau of Census & Bureau of Industrial Economics

Figure 366.9

SIC 3661: Telecommunicatons Equipment
Exports and Imports



Selected Years

Source: Bureau of the Census and Bureau of Industrial Economics

The two have thus far balanced each other out, netting a reasonably steady rate of growth in import levels over the past decade.

Exports: Exports of communication equipment have maintained a higher level than imports since 1972, except for the brief spurt in imports in 1976). However, their average annual rate of growth has been slower (9.6 percent).

In telecommunications equipment, in fact, the more rapid rate of growth in imports since 1976 has actually outpaced exports, resulting in a deficit in the Balance of Trade for this industry in 1983. Exports, meanwhile, have increased steadily between 1977 and 1982, as the U.S. expanded its exports market, particularly in developing countries where the establishment of telecommunication networks in just beginning. The 1983 leveling off was caused by a deterioration of all other currencies with respect to the U.S. dollar; however, projections for 1984 look promising, as these countries' economies recover. In addition, all of the developed countries have programs to convert their telephone networks to integrated digital systems. As in this country, however, the access to these markets is still somewhat impeded by the government- or semi-government controlled telephone equipment procurement practices. Movement is under way to liberalize key markets in Britain, Canada and Japan. This bodes well for U.S. firms, whose technological superiority and experience, particularly for communication equipment for commercial uses in competitive markets will find them well prepared for the competition once these new markets open up.

Exports in radio and television communication equipment, meanwhile, increased at an average annual rate of 8.1 percent (1972 based real terms) between 1972 and 1983. However, between 1981 and 1983 real growth in

exports declined slightly by 2.6 percent. This leveling off is undoubtedly due to the world economic crunch and exports of radio communication equipment, radar apparatus, radio and tv broadcasting equipment, radio navigation equipment and alarm and signal systems ar expected to pick up again once the world economy rebounds. Japan, Canada, the U.K. and West Germany account for approximately one-third of all U.S. exports in this category.

Thus, although exports have shown a somewhat slower growth in the past few years in both sets of communications industries, the prospect for renewed growth in the near future looks promising. Telecommunication equipment may show a somewhat slower rate of recovery owing to the differences in cyclical patterns of export markets; however, the longer term prospect is optimistic.

Summary of Trade

Growth in both exports and imports has not substantially affected the ratio of trade to total domestic consumption and production, partly because these have managed to sustain a higher rate of growth during this period. The prospects for the future indicate that the export market will regain its lead in both telecommunications and radio and tv communication equipment industries. However, the net effect, at least in the short term, will be a negligible effect on the demand for domestic production.

Productivity Trends

Productivity in the communication equipment subsector has been increasing for production workers in these industries at an average rate of 2.7 percent per annum since 1967. The productivity of all workers has also been rising although at a lower rate (2.5 percent). If one looks at the

Figure 366.10

SIC 3662: Radio & TV Equipment
Exports and Imports

Selected Years

Source: Bureau of the Census and Bureau of Industrial Economics

average annual rates between two comparable years (1972 and 1979) the annual increases in productivity are even greater: 3.8 percent for production workers and 3.5 percent for all workers (see Table 366.5).

Factors affecting the productivity increases in communications equipment include:

simple production techniques and automation, particularly in the manufacture of electronic switches and components.

scrapping of less efficient manufacturing operations in favor of more efficient ones, particularly between 1981 and 1982.

consolidation of distribution and support centers.

the introducton of numerically controlled machine tools which are both more efficient in production and more flexible in terms of producing equipment tailored to customers' needs.

the change in the nature of competition in telecommunications equipment, which has provided strong incentives for suppliers to reduce costs and increase productivity in order to be able to reduce prices and remain competitive.

the nature of the output of the production process is changing in these "high-tech" industries. This affects productivity because while the number of units may not necessarily change, their quality is enhanced. This factor is offset to some degree by the relatively high costs of research and Development incurred by communication equipment companies in order to maintain their edge on technolgical developments. It is also offset to some extent by the fact that gains in "absolute quality" of product may be translated into the market palce at a lower price in order to maintain competitiveness.

Given that the existing conditions favor productivity gains, it is most probable that they will continue to increase over the projection period.

Summary

The nation's employment in the communications equipment subsector has remained relatively stable over the past fifteen years. In recent years employment has been climbing despite the recession. Domestic demand has

Table 366.5
SIC 366: Productivity Trends

Year	Employment Index: Production Workers	Employment Index: Total Employment	Production 1967 Index	Productivity Index: Production Workers	Productivity Index: Total Employment
1967	100.0	100.0	100.00	100.0	100.0
1970	100.0	97.9	105.8	105.8	108.1
1971	92.7	87.5	97.5	105.2	111.4
1972	91.3	85.6	101.4	109.7	118.5
1973	93.8	87.4	108.8	116.0	124.5
1974	94.9	89.0	114.1	120.2	128.2
1975	87.4	85.4	105.6	120.8	123.7
1976	84.7	83.2	110.1	130.0	132.3
1977	89.1	86.2	118.6	133.1	137.5
1978	95.4	91.9	131.0	137.3	142.5
1979	103.8	97.6	148.4	143.0	152.0
1980	105.6	101.1	155.0	146.8	153.3
1981	106.9	104.0	161.5	151.0	155.3
1982	105.5	106.8	167.4	158.7	156.7
Annual Growth 1967-82	.37%	3.15%	3.2%	.41%	3.0%

Sources: Employment data from Employment and Earnings reports; production index from Federal Reserve Bulletin, cited in Predicasts Basebook.

been increasing at an annual rate of 6.5 percent during this period and is expected to increase at an even greater rate in the next five to ten years. Since the balance of trade is expected to remain negligible with respect to industry shipments, the demand for domestic production will increase at a rate of betwen 5 to 8 percent in the projection period.[1] This rate is higher than the projected annual rate of increase in productivity which is less that four percent. The net effect will be an increase in employment of between one and two percent annually over the projection period. The structure of employment growth in terms of occupations will be varied, however. While technological advances, automation and cost reductions are improving productivity and putting a negative pressure on employment of production workers, the competitive, high technology demands of the industry are increasing the demand for engineering and technical personnel as well as those in management and marketing.

Ohio's Outlook

Because Ohio's breakdown of employment is concentrated more heavily in telecommunications equipment, the trends in this industry will have a greater impact on Ohio than on the nation as a whole. The level of output in the industry is likely to increase in the short term simply as a function of competition. In and of itself, this will have a positive effect on employment. The continued long-term demand for domestic production and in particular for Ohio production in this industry will depend upon how competitive the existing firms remain, and upon the extent to which Ohio is successful in attracting new competitive business to locate within its borders.

At the present the outlook does not appear to be too optimistic. Western Electric, AT&T's former captive supplier, dominated the telephone equipment market prior to deregulation. Much of this company's manufacturing process involved long production runs of standardized telephone products which have become obsolete in the new competitive environment. Western's share of the market, particularly in the more competitive high-tech areas such as PBX market, have been slipping. Standard & Poor's industry analysis indicates that efforts by Western Electric to rationalize production facilities should help in the long term but the short-term outlook is somewhat bleaker. In Ohio this means that competing firms will have to pick up the slack of possible production plant closings and/or employment declines. At this writing, Dunn's Business Ranking, 1984 lists no new major employers in Ohio in this industry.

Although Ohio's percentage of subsector employment in SIC 3662 is smaller (30 percent of SIC 366), information available for radio and television communication equipment firms in Ohio is a little more complete. The 1982 Census of Manufacturers shows that Ohio ranks ninth in total number of firms in SIC 3662, and eleventh in number of firms with 20 employees or more. This is not large, considering the fact that Ohio ranks sixth in terms of population; however, it indicates some growth potential. Ohio has the largest percentage of small firms (less than 20 employees), possibly indicating a concentration on specialized high technology firms rather than on large production plants. Since the industries in this category of communications equipment are expected to grow at a faster rate than telecommunications, this likely to result in a shift in the industrial structure of Ohio's communication employment over the projection period.

While it is difficult to assess the effect that growth in these high-technology industries will have on employment in communication equipment, both nationally and at the state level, it may be worthwile to consider this growth in the broader economic context. The importance of technological progress in communications equipment cannot be measured simply in terms of the demand for the output of its products or by the effect on the level of its employment. The implications of the expanded services the new equipment provides to other industries such as news services and medicine will have a fundamental impact on overall economic growth, not only in Ohio and the U.S, but also worldwide.

NOTES

[1]Given that the price deflator used to adjust demand into constant dollars is a general deflator for producer durables, and the fact that prices in communications equipment have increased at a lower rate than other durable goods due to increased competition, this estimate and projection of demand is probably conservative.

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SECTOR 37

Transportation Equipment

Ohio Employment: 1965-1990

WORKING DRAFT
December 1984

[For discussion only]

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Professor Emeritus of Economics

Employment Forecasting Division
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SIC 37

TRANSPORTATION EQUIPMENT

This sector includes establishments manufacturing motor vehicles and motor vehicle equipment (SIC 372), aircraft and parts (SIC 372), ships and boats (SIC 373), railroad equipment (SIC 374), motorcycles, bicycles and parts (SIC 375), guided missiles and space vehicles and parts (SIC 376), and miscellaneous transportation equipment (SIC 379).

Employment in this sector is highly concentrated in two subsectors--motor vehicles and aircraft. In Ohio these subsectors contained 93.4 percent of the sector employment in 1979--a peak year--and 93.8 percent in 1983--a recession year (see Table 37.1). Concentration was less intense at the national level with ratios of 76.1 percent and 76.0 percent in the same years.

This structural difference accounts in large part for the decline in Ohio's share of national industry employment between 1979 and 1982. At the national level employment dropped by 15.5 percent for the sector as a whole and 23.5 percent in the motor vehicle subsector. Given the heavy weight of this subsector in the Ohio economy, the state's share of the industry employment has declined through the recession. Conversely, ship building has been relatively stable in this period, due to military contracts, while missle production has increased by 39 percent. Employment in both subsectors is negligible in Ohio. The growth of SIC 376 (missiles and components) will produce a long-term structural shift in Ohio's share. However, the weight of this subsector in the national total was only 4 percent in 1979 and 8 percent in 1982 (see Figures 37.1 and 37.2). Given

Table 37.1
SIC 37: Transportation Equipment
Employment: United States and Ohio, 1979 and 1983

SIC	1979 U.S.	1979 %	1979 Ohio	1979 %	1983 U.S.	1983 %	1983 Ohio	1983 %
37	2077.2	100.0	165.8	100.0	1756.3	100.0	131.6	100.0
371	990.4	47.7	120.1	72.4	757.8	43.1	86.9	66.0
372	610.8	29.4	34.8	21.0	578.5	32.9	36.6	27.8
373	226.4	10.9	1.4	0.8	188.5	10.7	.5	.4
374	74.3	3.6	4.6	2.8	30.3	1.7	1.4	1.1
375	—	—	2.3	1.4	—	—	2.4	1.8
376	101.5	4.9	—	—	139.8	8.0	—	—
379	54.3	2.6	2.6	1.6	46.5	2.6	3.8	2.9

Figure 37.1

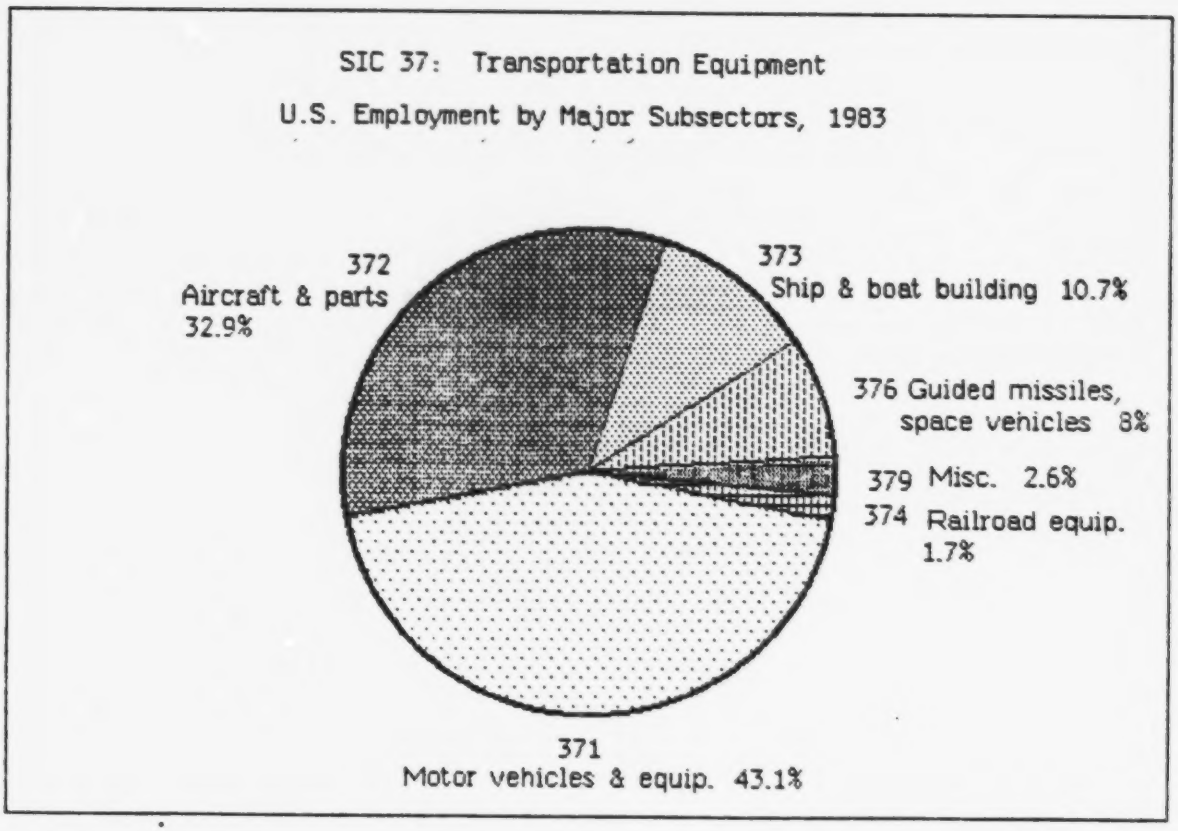
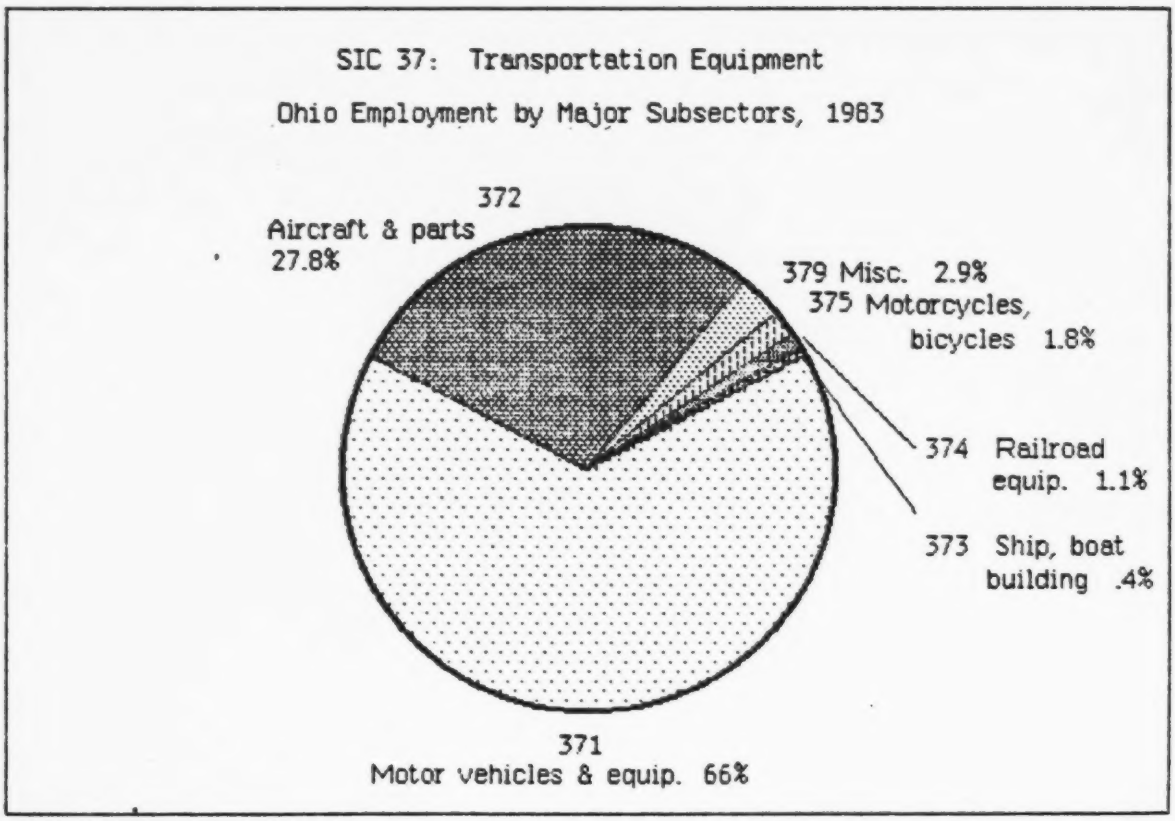

SIC 37: Transportation Equipment
U.S. Employment by Major Subsectors, 1983
372
Aircraft & parts
32.9%
373
Ship & boat building 10.7%
376 Guided missiles,
space vehicles 8%
379 Misc. 2.6%
374 Railroad equip.
1.7%
371
Motor vehicles & equip. 43.1%

Figure 37.2


SIC 37: Transportation Equipment
Ohio Employment by Major Subsectors, 1983
372
Aircraft & parts
27.8%
379 Misc. 2.9%
375 Motorcycles,
bicycles 1.8%
374 Railroad
equip. 1.1%
373 Ship, boat
building .4%
371
Motor vehicles & equip. 66%

its dependence on government contracts, its share of sector employment is not likely to exceed 6 percent in the long term. Its impact on Ohio's share of the sector employment will be negative but limited.

Table 37.2 illustrates the impact of cyclical change on industry employment at state and national levels. Through the three cycles after 1964, the average employment loss in the state has been about 3 percentage points greater than the national loss in periods of contraction and the gain has been about 3 percentage points less than the national gain. Although this pattern suggests some secular decline, much of this difference has developed in the current cycle and appears to reflect the magnitude of the current recession and its impact on motor vehicles and equipment.

The employment indices in Table 37.2 indicate that the difference in U.S. and Ohio performance in the latter period (1975-1982) in terms of peak to peak and trough to trough changes was not distinctly different than in the longer period. Again, the impact of the 1979-1982 recession on the auto industry and the weight of that sector in Ohio's transportation equipment sector appear to be the dominant factors. How persistent these changes may be is examined in a following section of this paper.

Projections to 1990

Table 37.3 contains employment projections for Ohio to 1990[1] for three-digit sectors. In the aggregate, employment in this sector in 1990 should be approximately 5.2 percent or 8,700 employees below the 1979 level but about 13.3 percent above the 1980 level. U.S. employment is projected to be about equal to the 1979 level in view of the projected growth in the production of missiles and components.

Table 37.2

Sector 37: Transportation Equipment
Employment: Ohio and the U.S., 1965-1982

Year	Employment (000's) U.S	Ohio	Ohio Share (Percent)	Percent Change U.S.	Ohio
1965	1679.1	143.2	8.53	--	--
1968	1948.4	166.4	8.54	+16.0	+16.2
1970	1686.1	152.9	9.07	-13.5	-8.1
1973	1929.3	167.2	8.67	+14.4	+9.4
1975	1715.0	140.8	8.21	-11.1	-15.8
1979	2082.7	165.8	7.96	+21.4	+17.8
1982	1726.0	121.7	7.05	-17.1	-26.6

Source: Bureau of Labor Statistics.

Table 37.3

Sector 37: Employment, 1979 and 1983 Actual and 1990, Projected

SIC		Employment Ohio 1979	1983	1990 low	1990 base	1990 high	Period Growth Rates (%) U.S. (Base) 1990/78	Ohio (Base) 1990/78
371	Motor Vehicles & Equipment	120,100	86,900	105,300	106,500	107,400	-9.6	-11.3
372	Aircraft & Parts	34,800	86,600	38,200	39,100	42,500	+9.0	+12.4
373	Ship, Boat Building	1,400	500	500	700	900	+12.4	-50.0
374	Railroad Equip.	4,600	1,400	3,000	3,400	3,900	-23.3	-26.1
375	Motorcycles, Bicycles, Parts	2,300	2,400	3,200	3,600	3,700	-1.0	56.5
376*							+60.0	--
379	Miscellaneous	2,600	3,800	3,200	3,800	4,000	-46.0	+46.2
TOTAL 37		165,800	131,600	153,400	157,100	162,400	+.2	-5.2

*Ohio employment in Sector 376 is included in SIC 379.

Ohio's employment in SIC 375 (motorcycles, etc.) shows a high relative growth because of the increasing concentration of the sector in the State, although the absolute numbers are relatively small. The growth in miscellaneous transportation equipment (SIC 379) is also relatively large but involves under 4,000 employees. Its growth in contrast to the national sector is a result of the continued growth of military expenditures. Positive or negative growth rates for the dominant sectors (autos and aircraft) correspond rather closely to the national industry change rates, as does the large relative decline in SIC 374 (railroad equipment).

The analysis on which the projections for motor vehicles and equipment and aircraft and parts are based is contained in the following sections.

NOTES

[1]The employment projections for 1990, below, are based in part on the industry growth rates associated with the BLS 1995 projections for the national economy and the detailed analysis for each major three-digit sector which follows. The BLS growth rates that are utilized are trend rates from actual 1979 employment to their 1995 projections. These rates are used in lieu of their published 1982-1995 rates because the unemployment rate in 1979 was similar to the rate assumed in the 1995 projections. Consequently, the 1990 projections in Table 37.4 below are growth projections with an implicit 6 percent unemployment rate rather than predictions of the level of economic activity for a given year.

Sector 371: Motor Vehicle and Motor Vehicle Equipment

This sector includes establishments manufacturing passenger automobiles, trucks, commercial cars and buses and special purpose vehicles, truck and bus bodies, motor vehicle parts and accessories and truck trailers.

The Employment Record

Employment in this industry reached a record high in 1978 with 1,005,000 wage and salary workers. It remained within 2 percent of that level through 1979 and then dropped by over 20 percent in 1980. By 1982 it had reached a low of 705,000, about 30 percent below the 1978 peak. A recovery beginning in 1983 has continued at an accelerated pace in 1984. Based on the first seven months, employment this year should average about 898,000, an increase of 27 percent over 1982 but about 11 percent below the 1978 level.

The structure of employment in the sector has changed very little through this period (see Table 371.1). In 1978, 47 percent of sector employment was in subsector 3711 (motor vehicles and car bodies). Another 45 percent was in subsector 3714 (motor vehicle parts and accessories) with the residual 8 percent divided 5 and 3 between truck and bus bodies and truck trailers. The only significant structural shift by 1984 is due to the rapid growth in the production of truck trailers as a result of deregulation. In contrast to the sector as a whole, employment in this subsector should average about 15 percent above the 1978 level. However, this represents a gain of less than 5,000 employees and a share increase of less than one percent of the sector total.

Table 371.1

Motor Vehicles and Motor Vehicle Equipment
Employment in selected years: 1978-1984

SIC	Vehicles (3711)	Truck Bodies (3713)	Parts (3714)	Truck Trailers (3715)	Total
1978	469.8	45.3	451.9	32.3	999.3
1979	463.0	46.1	441.1	34.7	984.9
1980	368.1	39.7	349.5	27.1	784.4
1982	317.5	31.5	323.3	20.1	692.4
1984*	416.1	39.2	405.5	37.1	897.9
			Percent		
1978	47	05	45	03	100.0
1979	47	05	45	03	100.0
1980	47	05	45	03	100.0
1982	46	04	47	03	100.0
1984	46	04	45	04	100.0

*Estimated on first seven months.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings.

The magnitude of change has been greater for Ohio's share of this industry than for the nation as a while. The state's employment dropped from 12,000 in 1978 to 78,900 in 1982, a loss of 37 percent. It has also been slower to recover. The estimated 1984 annual average is about 94,000 or about 76 percent of the 1978 peak. At a rate of recovery comparable to the industry nationally, Ohio's employment in 1984 would be about 108,000. The actual lag amount to about 14,000 jobs.

The extent to which this lag reflects relocation of the industry or is simply a structural shift associated with the recession and the sectoral composition of Ohio's share of output is not clear, and the available data are not sufficiently detailed to permit analysis. Ohio is the major producer of truck and bus bodies--the lagging subsectors in the industry. It is not an important producer of truck trailers, the most dynamic subsector. These sectors are, however, very small and the structural shift between them could not account for a major part of the lag. However, there is enough product diversity in the two major subsectors to account for the residual.

Two-thirds of Ohio's employment loss in this industry occurred in one year--1980. Further, the cyclical decline was more rapid and deeper than the national pattern, suggesting that the sectoral composition of Ohio's share of production is a more credible explanation of lagging recovery than is regional competition. A relationship between changes in Ohio's share and the level of employment in the industry can be observed in the experience of the last 19 years. In 11 of these years Ohio's share of national industry employment increased in years of employment growth and declined in years of contraction. It lagged behind the national economy in

the economic expansion of 1972, 1973, 1976, 1983 and 1984 and in the contractions of 1970 and 1974. It appears to move with the level of economic activity except in periods of extreme change when it moves with a lag of one or two years (see Figure 371.1).

At the same time, the State's share averaged about 12 percent between 1976 and 1983 and between 1965 and 1969, compared with an average of 13.2 percent in the period 1970-1975. Although this experience may indicate some relocational shift, it is also associated with the level of employment. In the "low" share periods, Ohio employment averaged 102,300 while in the "high" share periods it averaged 114,100. It seems most probable that the recent decline in the State share is primarily a function of cyclical change but it is also possible that some regional loss is present and may be of increasing importance in the future.

Projections to 1990

Table 371.2 presents the BLS projections of employment for this sector in 1990 for the United States and OSU/CHRR projections for Ohio. Two versions or sets of national projections are shown in the Table. Set (1) is the set of projections published by the BLS in the Monthly Labor Review (November 1983), and in BLS Bulletin 2197. The second set (2) was obtained by interpolating between 1979 and the BLS projection for 1995. This was estimated for two reasons. First, because BLS projections for 1990 were not available for all sectors and, second, because for many sectors, particularly motor vehicles, the actual projection is not consistent with current evidence. In this sector 1984 employment is running about 66,000 above the 1990 base projection and the 1995 estimate is nearly 40,000 below the current actual level. In view of this difference and for the reasons

Figure 371.1

Ohio's Share of National Industry Employment
Motor Vehicles and Equipment, 1965-1983

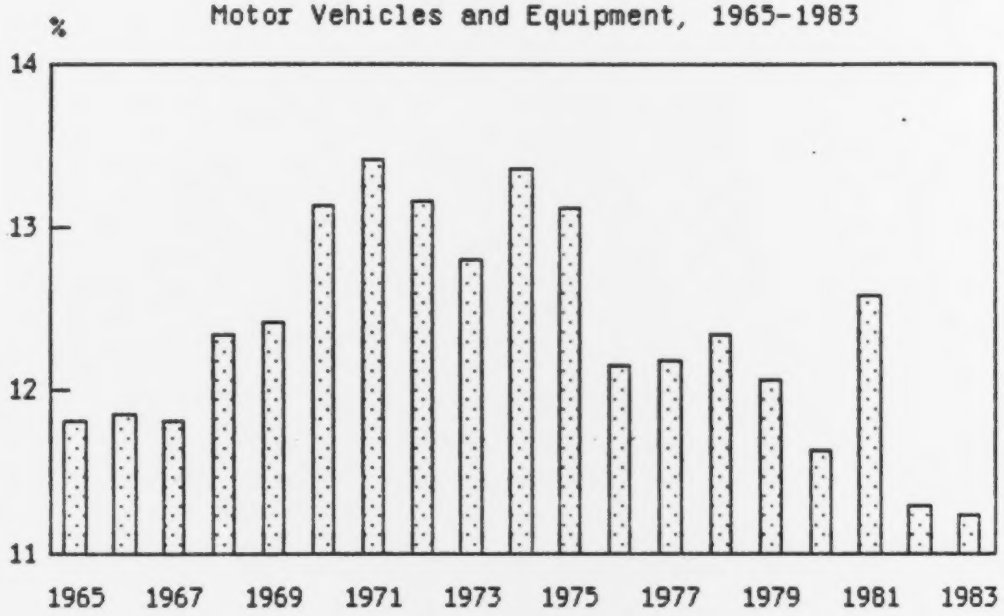


Table 371.2

Motor Vehicles and Motor Vehicle Equipment
Employment: U.S. and Ohio
Actual and Projected, 1979-1995
(thousands of employees)

	United States		Ohio	Ohio Share (percent)	
Actual					
1978	1,004.9		123.2	12.3	
1979	990.4		120.1	12.1	
1980	788.8		90.1	11.4	
1982	704.4		78.0	11.0	
1984	897.9		94.3	10.5	
Projected:	BLS	BLS'			
1990	(1)	(2)		(1)	(2)
Low	794.0	890.0	100.0	12.5	11.2
Base	834.0	900.0	106.0	12.7	11.7
High	828.0	908.0	107.5	12.9	11.8
1995					
Low		847.0			
Base		860.0			
High		871.0			

(1) BLS Projections.

(2) Estimated by interpolations between actual 1979 and BLS 1995 projections.

discussed below, we have based our projections on the interpolated estimates of 890 to 908 thousand in 1990. This estimate falls on a log-linear trend line between two years with comparable actual (1979) and assumed (1990) levels of unemployment at 6.3 percent (Base). In view of this high unemployment assumption even these interpolated projections are conservative.

Both sets of projections reflect three alternative scenarios which are described in the publications cited above. In the main, they represent alternative assumptions of labor force growth as functions of varying economic and demographic conditions.

The Ohio estimates are based on regressions of Ohio's share of national industry employment in the period 1965 to 1983 and the interpolated BLS projections for 1990. Obviously, these projections are very sensitive to the choice of base period for the regression analysis. A simple linear regression of Ohio employment over the period 1965-79 would lead to a 1990 estimate of 135,000. A similar projection based on the entire period 1965-83, independent of any national industry estimate, would produce a 1990 projection of 95,400. The inclusion of the current or recent recession in the data base has a profound effect on the outcome because of its magnitude.

In some sense the projection analysis that follows is an attempt to determine the extent to which the recent experience represents a radical departure from the long-term trend or simply a short-term cyclical deviation from that trend enhanced by inappropriate policy interventions.

Employment in this industry is affected by long-term shifts and short-term fluctuations in product demand, by structural shifts in

industrial location within the United States, by international competition and by product and process technology. A cursory look at the historical data suggests that the dominant factors are short-term cyclical fluctuations of the national eeconomy influenced by monetary and fiscal policy, foreign competition and technology. In the long term, the latter two may be partially off-setting rather than complementary as at present.

The data in Table 371.3 below represent an attempt to estimate the relative impact of these factors on employment in Sector 3711 (motor vehicles and passenger car bodies) between 1978 and 1984 for the United States. Although the analysis is limited to one subsector of sector 371, the conclusions should be applicable to the sector as a whole, since the structure of the sector did not change significantly in this period.

Table 371.3

SIC 3711: Passenger Cars and Truck Bodies
Employment: Gain or Loss to Imports, Productivity and Demand
1978-1984

	Trend	Import Effect	With Imports	Productivity Effect	With Productivity & Import Effects	Demand Effects	Actual
1978	571	-101	470	--	470	—	470
1979	576	-117	459	+17	476	- 13	463
1980	582	-121	461	+57	518	-150	368
1981	588	-118	471	+38	509	-150	359
1982	594	-112	482	+22	504	-186	318
1983	600	-121	479	-16	463	-112	351
1984	605	-121	485	-20	465	- 49	416

The analysis estimates a trend level of labor requirements assuming zero imports and constant productivity at the 1978 level and that demand

increases at an annual rate of one percent. With these assumed conditions, employment in 1978 would have been 571,000, increasing steadily to 605,000 in 1984. The actual level in 1978 was 470,000 and a preliminary estimate for 1984 suggests that it will be about 416,000 or 30 percent below the trend level.

On average through the period, imports and demand deficiencies reduced domestic labor requirements by 210,000 jobs. This loss was partially offset by declining productivity in the period 1979-82 equivalent to an average gain of 14,000 jobs. The net loss to all three factors, imports, demand and productivity averaged 196,000. Imports accounted for 59 percent of the net loss or an average of 110,000 jobs. Demand deficiences contribute 48 percent of the loss or 94,000 jobs while productivity change produced a seven percent gain.

The positive employment effects of declining productivity is obviously a short-term phenonemon related to the magnitude of the economic recession and consequent diseconomies of scale with low rates of capacity use. in the long term, productivity changes should be positive and a major contributor to reduced labor requirements. The demand effects estimated for this period appear to be induced by short-term cyclical fluctuations enhanced by monetary and fiscal policy. There is no strong indication of secular decline in the demand for motor vehicles and equipment.

In contrast, the effect of imports on employment is both large and persistent, at least in the present policy framework. It is difficult to estimate the strength of domestic demand for imports with the existence of voluntary quotas but it is reasonable to assume that increasing producitivity in domestic production with increasing demand and

technological change will cut into the import market by 1990. The discussion which follows explores, in rather limited depth, these probabilities as the basis for estimating future employment in the industry.

Product Demand

The demand for automobiles is highly sensitive to cyclical fluctuations in employment and income and to motor vehicle prices and interest rates. Table 371.4 indicates the high and low levels of automotive output for the U.S. plus imports between 1950 and 1982, expressed in billions of 1972 dollars.

Between 1950 and 1952 the value of output fell by 6.1 billion dollars or 31.7 percent. Between 1955 and 1958 it declined by 10.3 billion or 41.2 percent. The three most recent fluctuations in demand for autos, 1968-70, 1973-75 and 1978-82 have had declines ranging from 7 to 11.2 billion dollars and 18.1 to 22 percent. In absolute terms, the two most recent fluctuations reflect the magnitude of major economic recessions back-to-back, the particular impact on automobile output of the energy crisis and the high interest and unemployment rates associated with current monetary and fiscal policy. In relative terms they indicate that the magnitude of adjustment is no greater than in earlier periods. The phenomenon of high unemployment in conjunction with rising prices and interest rates had a severe impact on the demand for motor vehicles after 1979. While the civilian unemployment rate increased from 6.2 to 10.5 percent between 1979 and 1981, the average price of new cars increased by 25.5 percent and the average interest rate on new car loans rose to 17.35 percent.

Table 371.4

Auto Output: Cyclical Change in Domestic Output and Sales of Imported New Autos, 1950-1982: (value in billions of 1973 dollars)

	Total Output (1)			Domestic Output (2)		
	High	Low	% Change	High	Low	% Change
1950	19.2			19.2		
1952		13.2	-31.7		13.1	-31.7
1953	18.6			18.5		
1954		17.2	-7.5		17.1	-7.6
1955	25.0			24.9		
1958		14.7	-41.2		13.9	-44.2
1960	21.3			20.3		
1961		17.7	-16.9		16.9	-16.7
1965	32.5			31.1		
1967		30.2	-7.1		27.2	-12.5
1968	37.6			33.4		
1970		30.6	-18.6		24.6	-26.3
1973	49.0			40.0		
1975		38.2	-22.0		29.2	-27.0
1978	54.1			42.5		
1982		44.3	-18.1		28.8	-32.2

1. Final sales and changes in inventories of new autos produced in the U.S. plus sales of imported new autos.

2. New autos produced in the U.S.

Source: US/DOC, Bureau of Economic Analysis, The National Income and Product Accounts of the United States.

As a result, consumers delayed car purchases and the average age of cars on the road increased from 6.3 years in 1979 to 7.2 years in 1982. In that year, 24 percent of the 107 million cars on the road were more than ten years old. Standard and Poor's has estimated that by 1984 these conditions have produced a "pent-up" demand of nearly 14 million cars and trucks.

Retail sales of passenger cars reached a low of 7,980 units in 1982, nearly 30 percent below the 1978 peak. In 1983, sales were 9.179 units and should be about 10,956 in 1984, only 2.8 percent below the 1978 peak and nearly 4 percent above the 1979 level.

The pattern of changes in the demand for trucks and buses, a producer's durable good, is similar to that of passenger cars, although the magnitude of the decline was more severe and the recovery less complete. The number of units sold fell from 3.9 million in 1978 to under 2 million in 1982, a drop of nearly 50 percent. Sales in 1984 are estimated to be 3.7 million units, 95 percent of the 1978 peak and 88 percent above 1982.

Obviously, cyclical forces have played an important role in the employment losses of this industry after 1979. On the other hand, current and historical data do not support an assumption of long-term secular decline in the demand for automotive produces.

The average value of U.S automobile output plus imports in constant (1972) dollars has increased rather consistently since 1950. In billions

of dollars, these averages are:

	Average	Index
1950-54	16.7	100.0
1955-59	19.5	116.8
1960-64	22.6	135.3
1965-69	34.0	203.6
1970-74	40.4	241.9
1975-79	49.0	293.4
1980-83	48.0	287.4

The 1990 output, projected by a linear regression of annual data through this period, would be valued at 61.1 billion 1972 dollars. Obviously the future is not likely to be a linear projection of the past as the stock of cars approaches some "saturation" point. In a study of the world outlook for the automobile industry the OECD has estimated that automobile sales in the United States will be about 11.3 million units by 1985, about 11.5 million units by 1990 and 12.0 million units by 1995. Although they assume a reduction in scrappage rates after 1985, their projection assumes that 80 percent of new car demand will be replacement demand. They also estimate the saturation level to be 700 cars per thousand persons in the population compared to an actual rate of 572 in 1980 and a projected rate of 558 in 1990. On these assumptions, their 1990 estimate of demand is just equal to actual demand in 1978 and 26 percent above the 1980 level.

In their projection the number of cars per thousand persons in the population in 1990 would be only 3 percent higher than the 1979 level and the scrappage rate would be only .3 of one percent higher. In view of the

fact that demand for automobiles for the period 1979-83 was nearly 12 million vehicles below the 1978 level and the consequent fact that the average age of cars in service in 1982 was 14 percent above 1979 and 26 percent above 1974, we believe their estimate for 1990 is unduly conservative.

If one assumes that new car demand in 1990 (first purchase) is equal to the 1979 level and that scrappage and replacement rates are 8 percent of the stock rather than 7 percent, total demand would be slightly above 14.3 million vehicles, or 24 percent above the OECD estimate. The assumption seems reasonable given declining fuel prices with a consequent increase in average number of miles per car per year, declining interest rates and the fact that the demographic "bulge" is in the age group 30-54 years. Although this is, in our opinion, a more realistic estimate, if the national economy maintains a normal or reasonable growth rate and interest rates move toward their long-term trend level, current economic policy suggests that a somewhat more conservative estimate of 13 to 13.5 million vehicles is reasonable.

Trucks and Truck Trailers

The demand for trucks and truck trailers should be more responsive to improving economic conditions than is the demand for passenger cars. As noted earlier, retail sales of light trucks fell by 51 percent between 1978 and 1981, while the demand for medium and heavy trucks (more than 14,000 pounds GVW) fell by the same ratio but with a one year lag. The recovery from these recession lows has been even more dramatic. Based on the first seven months of 1984, sales in this year should approximate 3,690,000 light trucks and 271,000 medium and heavy trucks for total truck sales of

3,962,000 units—about 2 percent above the 1978 peak. Most of the recovery is in light truck sales which should be about 5 percent above the 1978 peak level in 1984. Sales of heavier trucks, although showing an increase of 47 percent over 1982 will still be only 74 percent of their 1979 peak.[1]

The U.S. Department of Commerce analysis of this industry component in the 1984 U.S. Industrial Outlook projected sales of trucks under 10,000 GVW at 3,150,000 units and sales of trucks over 10,000 GVW at 250,000, a total of 3.4 million units in 1984. Their estimates for 1988 are: light, 3.5 million, and heavy, 400 thousand for a total of 3,900,000, or 95 percent of their 1978 peak. This 1988 projection is actually slightly lower than total sales in 1984 and it is lower in both light truck and heavy truck sales. A direct quantitative comparison of weight-differentiated sales is not possible as the Motor Vehicle Manufacturers Association weight classification (10,000 lb) used in the 1984 Outlook analysis differs from the 14,000 lb. limit used by the Department of Commerce's Bureau of Economic Analysis and reported in the Survey of Current Business, the source of Table 371.5.

The demand for trucks and truck trailers should be responsive to the same forces affecting the demand for passenger vehicles, the stock and inventory effects of the recession and low interest rates. In addition, the deregulation of the industry which has permitted longer trailers and tandem rigs, combined with product changes for weight reduction, has in effect increased the rate of obsolesence of the existing stock of trailers and to a lesser degree of heavy trucks. On the other hand, as the DOC industry analysis suggests, the development of mini-vans will reduce the demand for light trucks in non-commercial uses. These factors and the

Table 371.5

Retail Sales - Passenger Cars and Trucks, 1972-1984
Number of Vehicles (thousands)

	Total Vehicles	Passenger Cars			Trucks
		Domestic	Imports	Total	
1984	25,627	8,565	2,391	10,956	3,715
1983	21,067	6,793	2,386	9,179	2,709
1982	18,208	5,758	2,222	7,980	2,248
1981	19,042	6,209	2,326	8,535	1,972
1980	20,190	6,581	2,398	8,979	2,232
1979	24,354	8,232	2,327	10,559	3,236
1978	26,538	9,312	2,000	11,312	3,914
1977	25,856	9,109	2,076	11,185	3,486
1976	23,260	8,611	1,499	10,110	3,040
1975	19,631	7,053	1,587	8,640	2,351
1974	20,321	7,454	1,413	8,867	2,587
1973	—	9,676	1,763	11,439	—
1972	—	9,327	1,623	10,950	—
		Retail Sales Index			
1984	115.5	108.4	119.5	110.6	129.8
1983	94.9	86.0	119.2	92.7	94.6
1982	82.1	72.9	111.1	80.1	78.5
1981	85.8	78.6	116.3	86.2	68.9
1980	91.0	83.3	119.8	90.7	78.0
1979	109.8	104.2	116.3	106.7	113.0
1978	119.6	117.9	100.0	114.3	136.7
1977	116.5	115.3	103.8	113.0	121.8
1976	104.8	109.0	74.9	102.1	106.2
1975	88.5	89.3	79.3	87.3	82.1
1974	91.6	94.4	70.6	89.6	90.4
1973	—	122.5	88.1	115.5	—
1972	—	118.1	81.1	110.6	—

strength of the current recovery suggest that total demand in 1990 should be well above the 1978 level, in the area of 4.3 to 4.4 million vehicles.

The current recovery in the sales of trailers appears phenomenal. Based on the first six months of 1984, sales this year should approximate 288,000 units, 236 percent of the 1983 level and 137 percent of the 1979 peak of 209,506 units. The strength and speed of this recovery is clearly a response to the technological and regulatory factors noted above as well as the general economic recovery. The congruence of these forces make long-term predictions even more difficult and leads us to believe that the effects of these innovational factors will be reduced to a negligible level by 1990. In this event, trailer sales in that year will, at best, approximate the 1984 level.

Imports and Structural Relocation

The loss of motor vehicle production to others areas of the United States has not been a major cause of the employment decline of this decade. Between 1977 and 1983 Ohio's share of the national industry employment has fluctuated between 12.59 percent (1981) and 11.24 percent (1983). The extrapolated share for 1990, based on this period's experience is 11.84 percent, slightly greater than the 1980 ratio but below the average from 1968-79. At 1979 levels of national employment, the difference between the 1981 and 1983 Ohio shares is about 14,000 jobs. At 1980 levels of national employment it is about 10,000 jobs.

Some part of this shift in Ohio's share is attributable to a secular geographic shift of the industry but it is also a reflection of short-term structural change within the 3-digit industry, associated with general economic fluctuations. Since the components of the industry--auto and

trucks, assembly, trailers, parts and accessories--fluctuate at different rates and with varying lags, and as their relative weights in the Ohio industry are not identical with the national industry structure, Ohio's share of the national industry employment, aggregated to 3 digits, will vary through the course of cyclical movements.

The more significant source of structural loss of industry employment is the penetration of American markets by imports of automobiles, parts and accessories. In 1969, passenger car imports were less than 12 percent of total retail sales or about 1,120,000 vehicles. By 1978, imports had increased to 2 million or 21.5 percent of sales. Between 1979 and 1983, sales of imports remained almost constant, around 2.3 million units, constrained in the latter period by voluntary quotas. The import share of total sales fluctuated with changes in total sales, varying from 22.0 percent in 1979 to 27.8 in 1982 and 21.8 with the recovery in 1984. The radical drop in industry employment after 1979 was a result of a reduced demand for domestic vehicles rather than an increase in the sales of imports. With the increase in the output of domestics in 1984 to an estimated 8.565 million cars, the import share will drop to 21.8 percent--slightly lower than the 1979 level.

Imports have had more limited impact on trucks and bus sales and this competititon has been restricted mainly to light trucks. Further, the strength of imports in this area appears to be declining with the development of domestic compact trucks and mini-vans. There is, however, indication of developing foreign competition for medium and heavy truck sales.

The experience of the past five years does not provide an adequate basis for estimating the impact that the elimination of voluntary quotas on Japanese imports would have on domestic sales and production. The maintenance of "premium" sales prices suggests that the demand for imports is greater than current supplies and that the removal of constraints would lead to a resurgence of import growth.

Current foreign exchange rates have provided some stimulus to import demand but less so in the case of Japan than for European producers. The U.S. dollar appreciated by 9.8 percent over the yen between 1981 and August 1984. In contrast, it appreciated by 27.5 percent over the Deusche Mark and 54.2 percent over the UK pound in the same period. Consequently, a dollar decline with not have a significant impact on imports from Japan, but would increase the relative prices of imports from other areas.

The OECD argues that "there is a new general tendency, throughout the automobile industry to increase the share of international production and serve local markets from local supply points." With the principal exception of Honda, rapid growth has not led Japan to "a strategy of substituting direct foreign investment for direct exports from Japan." If the Honda expansion, the Nissan truck plant and the GM-Toyota agreement reflect movement in this direction, it could be argued that the importance of imports in the U.S. market may remain at or below the 1984 level in 1990.

The future impact of imports may be greatest in motor vehicle parts and accessories. The DOC reports that the value of imports in this sector increased at a compound rate of 20.8 percent between 1972 and 1983. In the same period, exports increased by 11.6 percent and the industry value of

shipments by 8.8 percent. In absolute terms, the value of imports increased by 3.66 billion current dollars, and 35.3 percent of that increase was between 1982 and 1983.

The effects of foreign exchange rates is most evident in this sector. While the value of imports increased by 35 percent, the value of exports dropped by 46 percent, so that net imports increased from a negative 500 million in 1982 to a positive 3.286 billion in 1983. In the absence of change in monetary and fiscal policy, foreign exchange rates will encourage continued out-sourcing of parts and accessories and the elimination of small domestic producers.

Sector Productivity and Technology

The annual rate of productivity change in SIC 371 betwen 1958 and 1967 was negative in the first half of the period and barely positive (.07 percent) in the last half. After 1967 it increased at an accelerating rate, averaging 1.11 percent in the period 1968-72 and a strong 2.57 percent from 1973 to 1977.

Output per employee hour, by BLS estimate, reached an all-time high in 1977 and then dropped by 7.8 percentage points to 1980. Between 1980 and 1983 it increased by 21.7 index points or 23.5 percent, with two-thirds of this gain coming in the last year. For the period 1977-83 this is a compound annual rate of 2.25 percent, only slightly lower than the average for the period 1977-83.

Our calculation for sector 3711 (motor vehicles and passenger car bodies) indicates that labor productiivty in this sector has been more volatile than in the sector as a whole. It dropped 11.2 index points between 1978 and 1980 and had recovered 16.9 points by the end of 1983.

The 1983 average was about 4.9 percent above 1977 and 3.5 percent above the 1978 peak. Obviously both total factor productivity and output per man-hour are strongly influenced by changes in the level of output and the sharp decline in 1980 is primarily a function of the drop in demand. By 1983 demand for passenger cars was rising at a fairly sharp rate and productivity increased by 13 index points over 1982. Truck demand continued well below the 1979 peak and productivity in 1983 was about 25 index points below the 1977 peak (see Table 371.6).

If the economy sustains an aggregate growth rate of four to five percent annually, sector productivity should approximate the averages of the past ten years. If current and projected rates of technical change in the industry are realized, labor productivity should increase at a rate above the historical pattern as the new technologies emphasize labor saving techniques. Estimates of the actual impact of technological change on employment tend to be soft and rely heavily on limited case studies.

The OECD world automobile industry study concludes that product innovations derive primarily from firm efficiency objectives and that both general options, increasing engine efficiency and decreasing body weight and wind resistence involve additional costs, including labor costs.

The major qualitative change in this decade will involve applications of electronics to improve performance, safety and passenger comfort. The United States is currently the principal user of electronic components with Japan second. By 1988 the OECD expects U.S. applications to be nearly four times the 1978 level and the percentage of devices used for engine and electric control purposes will drop from 78 percent to 41 percent, with 59 percent for safety systems, passenger comfort and instrumentation. These

Table 371.6

SIC 371: Motor Vehicles and Equipment
Indices of Productivity

	BLS (1)	DOC (2)	DOC (3)	DOC (4)	DOC (5)
1984		130.6			
1983	113.9	106.4	104.9	116.9	89.4
1982	99.7	99.4	97.0	103.9	79.1
1981	95.0	91.8	93.9	103.5	67.4
1980	92.0	103.2	90.2	97.4	63.9
1979	98.5	100.2	97.4	94.4	97.6
1978	99.7	101.3	101.4	96.0	114.2
1977	100.0	100.0	100.0	100.0	100.0

Source: (1) BLS - SIC 371: Output per employee hour. News, August 1984.

(2) DOC - SIC 371: Value of Manufacturers' shipments in constant dollars per employee hour. DOC/SCB.

(3) DOC SIC 3711: Value of final sales, in constant dollars of domestic new cars and trucks, per employee hour. DOC/SCB.

(4) DOC - SIC 3711: Value of final sales in constant dollars of domestic new cars per employee hour. DOC/SCB.

(5) DOC - SIC 3711: Value of final sales in constant dollars of domestic new trucks per employee hour. DOC/SCB.

qualitative gains should improve the competitive position of U.S. models in the domestic market.

The OECD study notes that technological change in the production process involves capital-labor substitution, design changes to reduce materials inputs and better inventory control. It suggests that information about these changes is relatively limited and is mostly concerned with the inpact of robots on car assembly. The primary use of industrial robots in Japan has been for materials handling, machining and press followed by spot welding. The reverse has been true of the United States. A recent study (Ito, 1982) estimates that by 1990 36 percent of U.S. applications will be in assembly, a labor intensive process. The OECD argues, on the other hand, that assembly applications are not feasible in all situations. Because of the fixed time cycle, higher levels of output require increasing numbers of robots and flexible manufacturing systems are a better alternative. They also suggest that assembly applications are limited by the state of sensor development and that final assembly applications are not likely "within the next few years."

The experience of Ford's Dearborn engine plant provides mixed signals concerning employment effects. A University of Michigan report indicates a reduction of shift personnel in the crankcase area from 66 before renovation to 35 after but admits that the higher figure reflected full capacity operation while the lower figure reflects oepration at 50 percent of capacity. This report also indicates that in 1977, two years before the renovation, hourly employment at the plant averaged 1,933. Two years after renovation it averaged 3,112, suggesting that demand and organizational factors have a greater weight on employment that do technological factors.

Elsewhere, Ford reported that hours worked per vehicle and vehicles per employee increased by 27 and 29 percent respectively for North American automative operations between 1980 and 1983 but that "not more than 20-30 percent" of this gain is attributable to technology, narrowly defined.

A more aggregate yardstick for estimating future productivity change may be the Japanese experience. Output per man-hour in constant dollars increased from 5.19 to 11.38 between 1970 and 1983; a gain of 7.4 percent annually. In contrast, productivity in the U.S. increased from $8.47 to $10.91 between 1970 and 1973 and then dropped to $10.26 by 1981; an annual gain of 2.3 percent in the initial period and of 1.8 percent for the whole period.

In the same period, total factor productivity increased at an annual rate of 4.7 percent in Japan and .7 percent in the U.S. It is relevant to note that the nearly 90 percent of the Japanese gain occurred between 1973 and 1981, and is obviously associated with the high levels of export demand generated by the oil crisis and rapid growth in their domestic market. In the U.S. these conditions were the inverse: the oil crisis reduced the demand for large vehicles and the sharp recession after 1979 was exacerbated by poor market conditions.

Clearly market conditions have been as important or more important than technological factors in affecting productivity changes. Further, these organizational and institutional changes respond to transitory conditions and are not likely be persistent contributors to productivity change. For the motor vehicle industry in the United States a sustained increase of 4 to 4.5 percent through 1990 independent of changes in market conditions, is likely to be a maximum.

Conclusion

There is sufficient potential demand for motor vehicles and products to maintain a rate of growth in output through 1990 that is comparable to the historical rate. Technological change will reduce unit labor costs and labor requirments at an increasing rate if the current economic growth rate is maintained. Rising productivity and product changes should make domestic vehicles more competitive with Japanese products and should induce some increase in the decentralization of the Japanese industry. The competitive position of the U.S. industry should also be enhanced by a decline in the dollar position relative to European and Japanese currency.

Two caveats are appropriate. One is that the reduction in the import share will depend in part on the propensity of industry to compete in the small-car market--a propensity that is diminished currently by the demand shift toward larger cars. The other is the rather strong possibility that the economy will pass through another recession in the interim, given the limited ability or commitment of the Administration to reduce the budget deficit and consequently interest rates and export prices.

SIC 372: Aircraft and Parts

At the national level, the employment structure of this industry has not changed appreciably since 1972. Employment in aircraft assembly (SIC 3721) has averaged about 53 to 55 percent, while establishments in SIC 3724 (engines and parts) have employed about 25 percent and those in SIC 3728, a slightly smaller share (see Table 372.1). In contrast, nearly 60 percent of Ohio's employment in this industry is in the manufacture of aircraft engines and engine parts, while only 13 percent is employed in aircraft manufacture and assembly (see Figures 372.1 and 2).

Employment projections in the sector are complicated by the fact that the sector serves several distinct markets and consequently responds to varying economic and political forces affecting those markets. In terms of the number of aircraft, the dominant market is for light, single engine aircraft. In terms of value, this industry component represents less than 3 percent of the industry total. However, it is very sensitive to the general level of economic activity and contributes, at least marginally, to the volatility of employment (see Table 372.2 and 372.3).

In peace-time, the dominant value share of industry shipments is in large commercial aircraft. In 1979 this industry component had shipments valued at 10.9 billion dollars, or 71 percent of the aircraft total. By 1983, the value of shipments was identical to the 1979 level in current dollars but considerably less in constant dollars, and the component share had fallen to 51 percent. This subsector has been responsive to the persistent and continuing growth in passenger revenue miles but the air transport industry is experiencing serious structural problems stemming from the radical increase in fuel costs and the impact of

Table 372.1

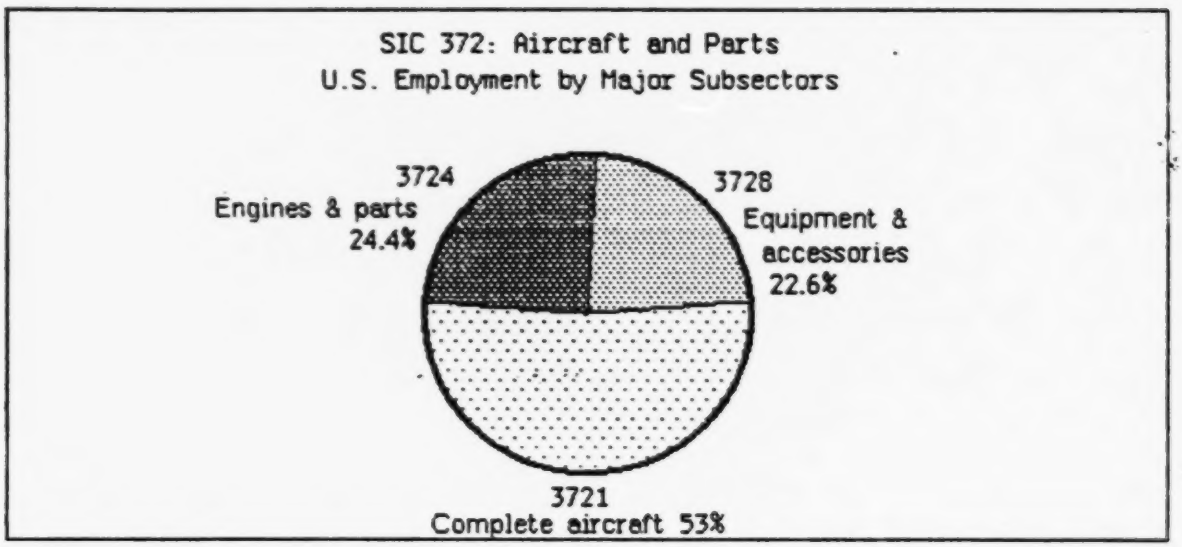
Sector 372: Aircraft and Parts
Employment, 1972-1983

	SIC 372	SIC 3721 Aircraft	SIC 3724 Engines	SIC 3728 Equipment
1983	578.5	306.7	141.3	130.6
1982	601.1	319.9	148.8	132.3
1981	645.5	344.2	162.5	138.3
1980	652.3	349.3	162.9	140.1
1979	610.8	333.2	151.6	126.1
1978	527.2	288.3	133.5	105.5
1977	481.7	270.4	120.9	90.4
—	—	—	—	—
1972	494.9	274.3	139.3	81.3

(Percent)

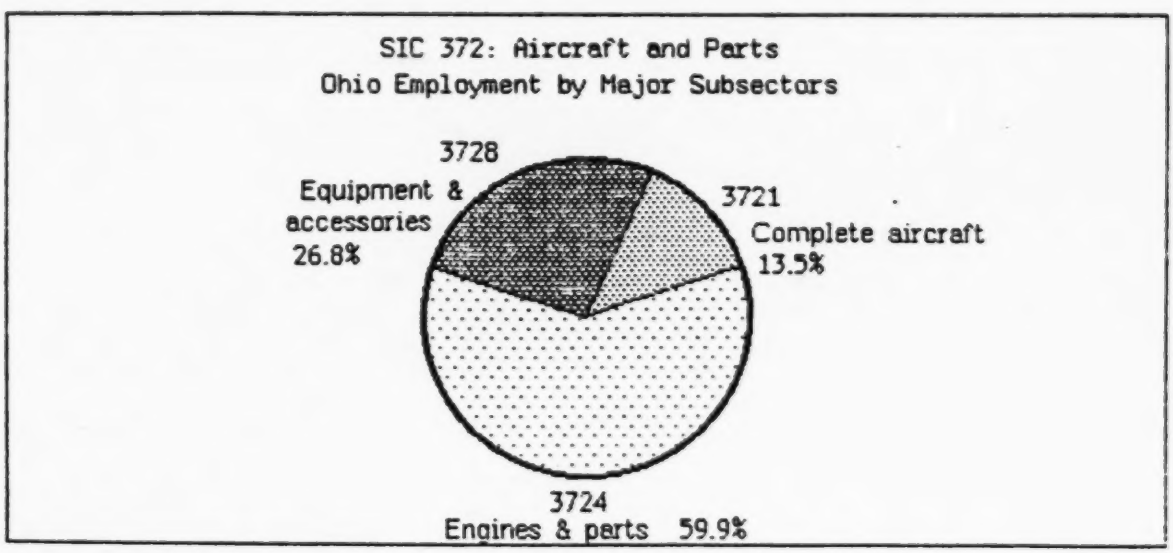
	SIC 372	SIC 3721	SIC 3724	SIC 3728
1983	100.0	53.0	24.4	22.6
1982	100.0	53.2	24.8	22.0
1981	100.0	53.3	25.2	21.5
1980	100.0	53.4	25.0	21.5
1979	100.0	54.6	24.8	20.6
1978	100.0	54.7	25.3	20.0
1979	100.0	56.1	25.1	18.8
—	—	—	—	—
1972	—	55.4	28.1	16.4

Figure 372.1



Source: Bureau of Labor Statistics

Figure 372.2



Source: Ohio Bureau of Employment Services

Table 372.2

Civil Aircraft Shipments: United States
1968-1984

	Total Units	Single Engine	Multi-Engine
1984*	3,640	2,000	1,640
1983	3,305	1,700	1,605
1982	4,579	2,546	2,033
1981	11,067	6,825	4,242
1980	13,130	8,175	4,955
1979	17,924	13,044	4,880
1978	18,882	14,382	4,500
1977	18,159	14,358	3,801
1976	16,446	13,019	3,427
1975	15,196	11,507	3,689
1974	15,117	11,470	3,647
1973	14,748	10,818	3,930
1972	9,988	7,898	2,090
1971	8,143	6,377	1,766
1970	8,190	6,029	2,161
1969	13,600	10,193	3,407
1968	14,969	11,269	3,700

*Estimated.

Source: Bureau of Industrial Economics

Table 372.3
Civil Aircraft Shipments: United States Index
(1972 = 100)

	Total Units	Single Engine	Multi-Engine
1984	36.4	25.3	78.5
1983	33.1	21.5	76.8
1982	45.8	32.2	97.3
1981	110.8	86.4	203.0
1980	131.5	103.5	237.1
1979	179.5	165.2	233.5
1978	189.0	182.1	215.3
1977	181.8	181.8	181.9
1976	164.7	164.8	164.0
1975	152.1	145.2	176.5
1974	151.3	145.2	174.5
1973	147.7	137.0	188.0
1972	100.0	100.0	100.0

deregulation on competition in the transportation market. In a period of uncertainty major airlines are postponing the delivery of new aircraft.

Since 1980 the decline in the demand for civil aircraft has been offset by the rapid increase in the demand for military aircraft, engines and parts. In 1979 military aircraft accounted for 29 percent of the value of aircraft shipments and 35 percent of engine shipments. By 1983 these ratios were 49 percent and 61 percent, respectively. In that period the current dollar value of military aircraft shipments increased by 135 percent and the value of military engine shipments by 196 percent (see Table 372.4).

Obviously, this market is primarily responsive to Federal government policy. The current expansion reflects the policy position of this Administration and the current debate over deficit reduction suggests that while some reduction in the military budget is probable, growth in expenditures will continue and this market will continue to be dynamic through the next several years.

A fourth market is the export market. In 1980, exports accounted for 26.1 percent of total aircraft shipments. By 1983, they accounted for nearly 40 percent of the total. In the same period exports of engines increased from 22 percent to 25 percent and exports of equipment were relatively constant at around 40 percent (see Table 372.5).

Although the value of imports of engines and equipment has increased substantially since 1979, it remains in 1983 less than half the value of exports. In complete aircraft, imports were only 11 percent of exports in 1983 and only 4 percent of total shipments in that year.

Table 372.4

SIC 372: Aircraft and Parts
Value of Shipments, 1979-1983
(millions of dollars)

	1979	1980	1981	1982	1983
Aircraft					
Total value	15,313	18,945	20,006	17,295	21,285
Military	4,430	5,892	6,869	8,655	10,400
Civil	10,883	13,053	13,136	8,639	10,885
Light	522	559	358	193	143
Heavy	9,958	11,821	12,143	8,040	10,400
Other*	403	674	636	406	340
Engines					
Military	1,113	1,473	2,198	2,600	3,300
Civil	2,168	2,840	2,746	2,190	2,100
Equipment	7,903	9,806	10,359	10,200	11,100
			Percent		
Aircraft					
Total value	100.0	100.0	100.0	100.0	100.0
Military	28.9	31.1	34.3	50.0	48.9
Civil	71.1	68.9	65.7	50.0	51.1
Light	3.4	3.0	1.8	1.1	.6
Heavy	65.0	62.4	60.1	46.5	48.9
Engines	100.0	100.0	100.0	100.0	100.0
Military	34.9	34.2	44.5	54.3	61.1
Civil	66.1	65.8	55.5	45.7	38.9

*Rotary wing.

Source: Bureau of Industrial Economics

Table 372.5

SIC 372: Aircraft and Parts
Value of Exports, 1980-1984

	1980	1981	1982	1983	1984
Aircraft	9,327.5	10,324.7	7,236.4	8,350.0	7,240.0
Civil	8,378.1	8,612.9	4,848.4	6,215.0	4,620.0
Military	949.4	1,711.8	2,388.0	2,135.0	2,600.0
Engines & parts	1,886.7	2,318.4	2,538.6	2,765.0	2,635.0
Parts & access.	3,585.0	4,234.3	4,433.5	4,553.0	4,772.0
Total	14,799.2	16,967.4	14,208.5	15,668.0	14,627.0
			Percent		
Aircraft					
Civil	.566	.507	.341	.397	.316
Military	.065	.101	.168	.136	.178
Engines & parts	.127	.137	.179	.176	.180
Parts & access.	.242	.255	.312	.291	.326
Total	100.0	100.0	100.0	100.0	100.0

Source: Bureau of Industrial Economics

Ohio's employment in Sector 372 has moved with the national industry. It reached a peak of 49,300 in 1968 in response to military demand. It fell to 31,000 in 1971 and remained relatively constant until 1979. Between 1979 and 1983 it averaged about 36,000. The relatively small variance is clearly related in the main to changes in military expenditures and in less degree to fluctuations in the general economy.

In the period 1965 to 1983 the Ohio share of the national industry employment has varied in a narrow range from 5.5 percent (1969) to 6.31 percent in 1983. The state's location quotient has varied from .99 in 1969 to 1.39 in 1983, signifying that Ohio's share of the industry employemnt is increasing relative to the national average (see Table 372.6 and 372.7, and Figure 372.3).

A linear regression of Ohio's share over this period would estimate the state's share to be 5.874 percent of national industry employment in 1990. If national industry employment reaches the level projected by the BLS, the projection for Ohio employment would be:

Published Estimates of Industry Employment Ohio			Interpolated Estimates of Industry Employment Ohio		
low*	base	high	low	base	high
42,100	39,900	39,000	41,000	39,200	38,900

Our original base projection, based on the 1980 BLS national projections, was 40,200. In view of the uncertainty concerning the final impact of deregulation on commercial air transport, we have revised our projection downward to 39,100 (base), a reduction of 2.7 percent.

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*Note: The low BLS series produces a high estimate in this sector due to the importance of military expenditures in this scenario.

Table 372.6
SIC 372: Ohio Aircraft and Parts
Employment, Employment Share and Growth Rates
1965-1983

Year	Employment	Share of National Industry	Growth Rates Ohio	Growth Rates U.S.
1965	35,500	5.72	—	—
1966	42,800	5.72	20.56	20.67
1967	47,000	5.67	9.81	10.66
1968	49,300	5.82	4.89	2.20
1969	44,000	5.50	-10.75	-5.58
1970	38,300	5.76	-12.95	-16.87
1971	31,800	6.05	-16.97	-20.87
1972	29,200	5.90	-8.17	-5.72
1973	30,800	5.86	5.47	6.06
1974	31,400	5.82	1.94	2.76
1975	28,600	5.56	-8.91	-4.70
1976	26,800	5.50	-6.29	-5.22
1977	27,700	5.73	3.35	-0.88
1978	30,400	5.78	9.74	8.84
1979	34,800	5.69	14.47	16.27
1980	38,000	5.79	9.19	7.26
1981	36,500	5.55	-3.94	.19
1982	35,400	5.78	-3.01	-6.83
1983	36,600	6.31	3.38	-5.23

Source: Bureau of Labor Statistics and Center for Human Resource Research.

Table 372.7

Location Quotient for SIC: 372

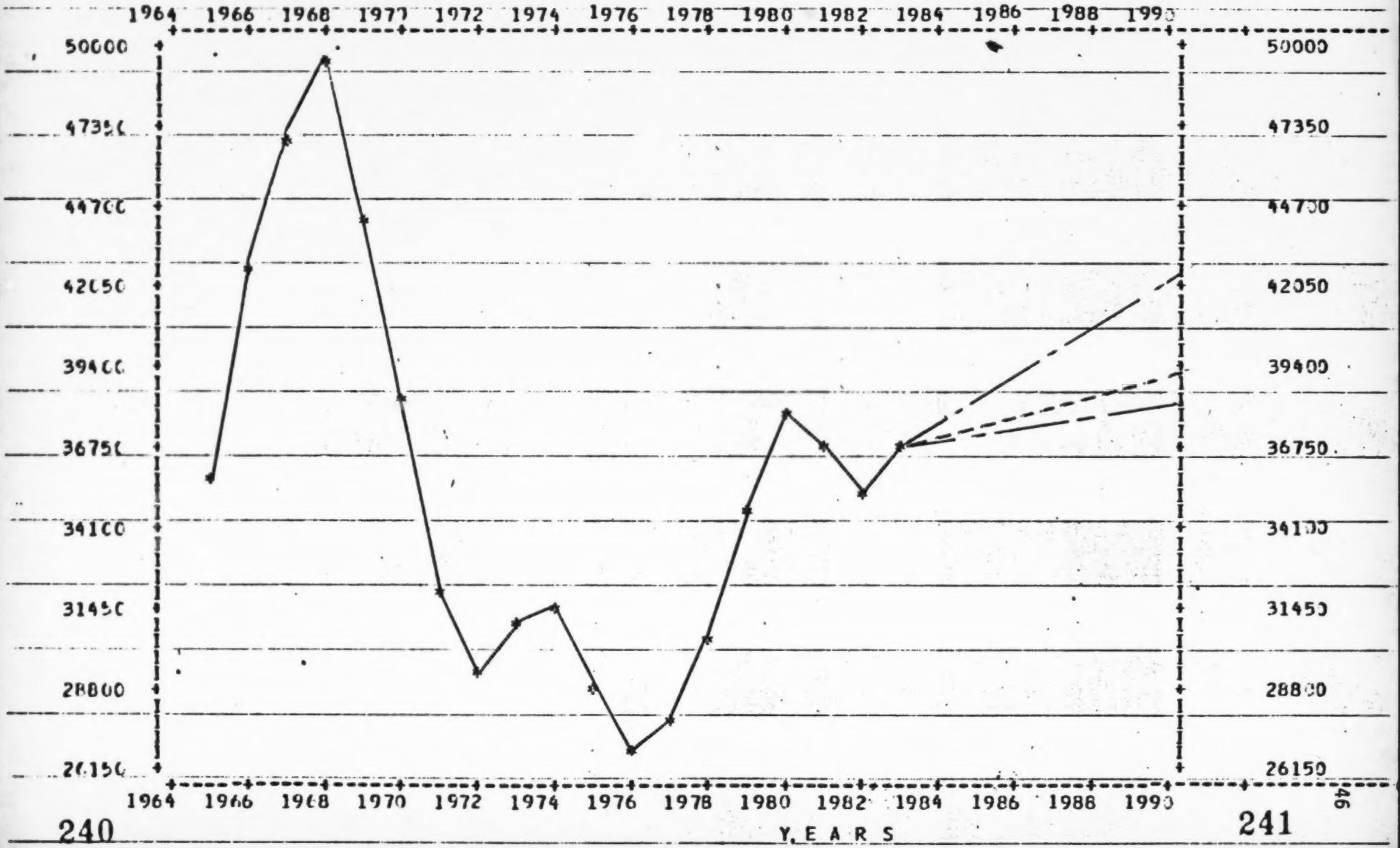
Variations from 1969-1983

1969	0.99
1970	1.05
1971	1.12
1972	1.10
1973	1.09
1974	1.09
1975	1.06
1976	1.06
1977	1.11
1978	1.13
1979	1.13
1980	1.18
1981	1.17
1982	1.28

FIGURE 372.3

INDUSTRY-EMPLOYMENT VS. TIME

AREA : OH0000 - OHIO
INDUSTRY : 413720 - AIRCRAFT AND PARTS



JUL 13 1987 REC'D Abstract

A Test of the Occupational Area-specific Staffing Information System (OASIS)

by

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Introduction

This report delineates a test of the Occupational Area-specific Staffing Information System (OASIS), developed by the Utah Employment Security Research Unit in 1982.[1] OASIS was developed by the Utah unit from "an automated methodology developed largely by the New Jersey Department of Labor and Industry, Division of Planning and Research."[2] The system is designed to produce reliable sub-state area estimates from data collected through the use of a sample drawn on a state-wide basis.

The need for such a system is obvious. As the OASIS Manual puts it: "Essentially, the problem in using OES to generate sub-state area data centers in sample design criteria. For each sub-state area added to the survey, sample size increases dramatically and soon becomes prohibitive in terms of cost and time."[3] Depending upon the number of sub-state areas added, the increase in the Ohio sample could easily vary from 50 to 100 percent.[4]

Since this increase in sample size proved impractical for many states, a variety of states (among them Colorado, New Jersey, Oregon, Texas, and Utah) began exploring methods to produce synthetic sub-state area estimates. These methods are categorized by the OASIS Manual as follows:

1. Based on the assumption that industry staffing patterns are the same in all areas, state-wide industry staffing patterns are applied to sub-state areas.

2. The second approach expands the first by also controlling for size: it assumes that two firms of the same employment size in the same industry will be staffed similarly. Thus, statewide industry data, disaggregated by size is applied appropriately in the sub-state areas.

3. This approach is based on the assumptions of the second with the added caveat that area differences arising from geographical locations should be controlled. The assumption here is that two firms in the same size category, in the same area and in the same industry will show even more similarity (due to the application of such factors as distance from markets, natural resource capability, diffusion of technology, etc).[5]

The Utah approach utilizes all three of these methods in a descending order of preference. The third method, called "area-specific," is the most preferred. Second is the "state uncollapsed" where data is disaggregated by both industry and size. Least preferred is the "state-wide uncollapsed," described in #1, where data is only disaggregated at the industry level. According to the OASIS Manual, "Research in the three methodologies has indicated that as the assumptions grew in sophistication, the reliability of the estimates moves toward the reliability of estimates produced by an expanded sampling approach."

What the Manual does not tell us is how closely the reliability is matched. This report will attempt a preliminary answer to that question, based on the use of data collected in the 1983 OES Survey of Manufacturing and Hospitals in Ohio.

Ohio Sample

The Ohio sample was drawn through the use of the SPAM System. Rather than selecting a state-wide sample, a sample was drawn at the 2-digit industry

level in each of the SMSAs. This resulted in a sample of 8,055 firms with an employment of 1,229,882. We were able to generate a response rate of 50.24 percent of firms and 55.65 percent of employment. Had we drawn at the state-wide 3-digit level, we would have had a sample size of 5,237 firms and an employment size of 1,162,279.[6] Thus, drawing a state-wide 3-digit sample results in an employment difference of only 67,603 but results in a sample difference of over 2,800. Put another way, a 54 percent increase in the sample of firms results in a 6 percent increase in sample size of employment. If the OASIS program produces accurate sub-state estimates, the savings in Ohio would be significant.

OASIS Analysis

In order to test the reliability of OASIS generated sub-state estimates, two SMSAs, Akron and Canton were selected because they had the highest and lowest rate of response respectively (65 percent of employment in Akron, 44 percent in Canton). Estimates were synthetically created for both SMSAs. As could be predicted, the Akron SMSA with an overall response rate of 65 percent utilized a much larger percentage of area-specific estimates. Over 84 percent of the Akron estimates were generated by area-specific estimates, compared with 54 percent in the Canton area.[7]

To test the reliability of the OASIS generated estimates, a comparison was made using the well-known Chi-square statistic.[8] In the Canton SMSA, the difference between sub-state estimates generated by OASIS and by the regular procedure resulted in a Chi-square statistic of 4,658; in Akron, the statistic is 958. Because of the large numbers involved, both are significant at the .001 level, although the Akron statistic is only some 20 percent as large as the Canton.

In order to analyze the difference in the degree of the relationships, we can utilize the measure ϕ^2 or X^2/N. This will result in a statistic that varies between 0 and 1.0, and is a more reliable measure than chi-square alone. For the Canton SMSA, ϕ^2 = .05; for Akron, .006.

Another statistic that can be used is the Index of Dispersion (ID). Here, the differences between the OES generated and the OASIS generated estimates are summed (disregarding positive or negative differences) and that total is divided by the sum of the total occupations in each set of estimates. This statistic also varies between 0 and 1.0 For the Canton estimates the ID is .1540, for Akron it is .0424. Another way of looking at the differences would be to say that the Canton OES and OASIS generated estimates vary by about 15.5 percent, the Akron estimates by about 4 percent.

If the data are aggregated into the traditional categories: managerial, professional and technical, service, sales, production, and clerical, the picture changes somewhat. Chi-square is still significant in the Canton SMSA, although greatly reduced (.187). In Akron, Chi-square is not significant, falling to a mere 1.90. Phi-square in Canton is .002; in Akron, .00001. These differences are illustrated in Table 1.

Table 1

	Canton		Akron	
	OASIS	OES	OASIS	OES
Managers	2716	2693	8678	8943
Prof. & Tech.	8881	7700	19793	20447
Sales	942	846	1491	1484
Clerical	5326	4953	8537	8816
Service	3112	2833	4926	5066
Prod. & Main.	29684	25063	29475	30633

The Index of Dispersion for the Canton SMSA is .12; for Akron, .04.

These differences, however characterized, are between two sets of estimates. Given the response rates, we would have predicted that the Akron estimates would have been "better" than the Canton estimates. And, indeed, there is less variation between variously generated Akron estimates than those in the Canton SMSA. How do these estimates differ from the real occupational distribution is a question we cannot answer with this data.[9]

Fortunately, in the Canton SMSA one 3-digit SIC—806 (hospitals)—had a response rate of 100 percent. We know, therefore, what the occupational distribution of that industry is; we can then manipulate response to discover how the OES and OASIS generated area-industry estimates vary.

In order to do this, we "removed" 40 percent of the response from the Canton SMSA hospital industry. We then generated two sets of estimates, using OASIS and the regular OES method. The results are illusted in Table 1.

Table 2

	100% - OASIS	100% - OES	OES - OASIS
X^2	1033	946	1827
$\emptyset^2$	.06	.055	.11
ID	.164	.168	.243

It is clear from these results that, at a 60 percent response rate, the OES and OASIS generated estimates vary more from each other than either does from the "real" occupational distribution. Of course, we would expect to see all of these differences reduced as the rate approaches 100 percent.

Conclusion

The decision of whether or not to use the OASIS program to produce sub-state area estimates will vary from state to state. Where no sub-state

estimates are currently produced, OASIS offers a low-cost method of producing a relatively reliable set of estimates. The OASIS Program, once mastered, can be efficiently utilized to produce estimates that are essentially as reliable as those produced through the regular OES estimates system.

Where sub-state estimates are currently produced, OASIS offers a cost-saving which should prove an attractive alternative to large samples with their added expense in all phases of the survey. In short, we recommend it highly.

NOTES

1. See letter from William R. Fischer to Professor Marcus Sandver, dated September 15, 1982 (on file at CHRR).

2. See the attached description to the above letter (hereafter referred to as OASIS Manual).

3. OASIS Manual, op. cit.

4. Extending the sample to cover the major MSAs could result in about a 50 percent increase. To extend it to all the Service Delivery Areas would probably double the sample.

5. OASIS Manual, op. cit.

6. Percentage of firms drawn by size category is as follows:

	OASIS (3-digit/state)	OES (2-digit/area)
0-9	22	45
10-19	26	52
20-49	38	66
50-99	53	79
100-249	77	90
250+	100	100

7. In Akron, state-uncollapsed generated estimates represented 10 percent of the total, state-collapsed, 5 percent. In Canton, state-uncollapsed represented 26 percent, state-collapsed, 20 percent.

8. The Chi-square (X^2) formula is $\sum \frac{(f_o - f_e)^2}{f_e}$, where f_o and f_e refer respectively to the observed and expected frequencies for each cell. For a discussion of Chi-square and Phi-square, see Herbert M. Blalock, Jr, Social Statistics (New York: McGraw-Hill, 1960), chapter 15.

9. We know, of course, that the relative error will be less in the Akron estimates (and that as the response rate approaches 100 percent, the relative error will diminish).